ZONE 3 ADVISORY COMMITTEE

San Luis Obispo County Flood Control and Water Conservation District

AGENDA

Thursday, July 20, 2023 6:30 P.M.
Oceano Community Services District
1655 Front Street, Oceano, California 93445

I. CALL TO ORDER AND ROLL CALL

II. PUBLIC COMMENT
This is an opportunity for members of the public to address the Committee on items that are not on the Agenda

III. OFFICER ROTATIONS
A. Committee Chair rotating from City of Arroyo Grande to CSA-12 Representative
B. Committee Vice-Chair rotating from City of Grover Beach to AG Member Representative

IV. APPROVAL OF MEETING MINUTES
A. March 16, 2023 – Attachment 1

V. OPERATIONS REPORT
A. Water Plant Operations, Reservoir Storage, Downstream Releases - Verbal Update
B. Projected Reservoir Levels – Attachment 2
C. May & June Monthly Operations Report – Attachment 3

VI. INFORMATION ITEMS
A. LAFCO Notice of Annexation – Weldon Property – Attachment 4
B. Cloud Seeding Seasonal Report – Attachment 5
C. Bathymetric Study – Verbal Update

VII. CAPITAL PROJECTS UPDATE
A. Bi-Monthly Update – Attachment 6

VIII. ACTION ITEMS (No Subsequent Board of Supervisors Action Required)

IX. ACTION ITEMS (Board of Supervisors Action is Subsequently Required)

X. FUTURE AGENDA ITEMS
A. ???

XI. COMMITTEE MEMBER COMMENTS

Next Regular Meeting is Tentatively Scheduled for
September 21, 2023 at 6:30 PM at City of Grover Beach Council Chambers
Agendas accessible online at www.slocounty.ca.gov/pw/zone3

SAN LUIS OBISPO COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
ZONE 3 ADVISORY COMMITTEE
MEETING MINUTES
THURSDAY MARCH 16, 2023

I. Call to Order and Roll Call -- The Zone 3 Advisory Committee Meeting was called to order at 6:30PM at the City of Arroyo Grande by Kristen Barneich. County Public Works Utilities Division Senior Engineer and Secretary to the Advisory Committee, David Spiegel, called roll. Quorum was present. Members in attendance were:

- Daniel Rushing, City of Grover Beach
- Kristen Barneich, City of Arroyo Grande
- Marcia Guthrie, City of Pismo Beach
- Shirley D. Gibson, Oceano Community Services District

II. Public Comment – This is an opportunity for members of the public to address the Committee on items that are not on the Agenda. No public comment.

III. Approval of Meeting Minutes

A. January 19, 2023 Special Meeting (Attachment 1 of the Agenda Packet) – ***Member Gibson motioned to approve; Second by Member Guthrie.*** **Voice vote.** ***Motion passed.***

IV. Operations Report

A. Water Plant Operations, Reservoir Storage, Downstream Releases— As of March 1, plant production was 2.3 million gallons per day (MGD); State Water was 1.0 million gallons per day (MGD); downstream release was off; Lopez Lake elevation was 517.75 feet; storage 45,053.5 acre-feet (AF) at 91.2% capacity; rainfall to date, since July 1, 2022, was 42.83 inches; rain compared to previous years is 200% above average.

i. David Spiegel explained that downstream release was initially decreased from 3.0 cubic feet per second (CFS) (or 2.0 MGD) to the 1.0 CFS minimum per the Interim Downstream Release Schedule but was ultimately shut off due to the evacuation order.

B. Projected Reservoir Levels (Attachment 2 of the Agenda Packet) — Review of the Lopez Reservoir Projections Chart.

i. Member Barneich asked when storage is expected to spill. David Spiegel explained it is expected to spill in eight days or during the upcoming storm event, whichever comes first.

ii. David Spiegel reported that Lopez Reservoir data is publicly accessible via the San Luis Obispo County website. Spillway discharge data has been added to the dashboard to track spillage.

iii. Member Gibson asked if the Board has changed the weather outlook for long-term. David Spiegel explained that the Board's decision to rescind the drought order has been postponed to April due to staffing issues related to storm response.

C. **January and February Monthly Operations Report (Attachment 3 of the Agenda Packet) —** Review of the monthly operations reports with the Committee.

No public comment was given.

V. Information Items

A. **2nd Quarter FY 2022/23 Budget Status (Attachment 4 of the Agenda Packet) —** County Public Works Zone 3 Accountant Megan Schotborgh provided an update on the 2nd Quarter Budget Status. The $7.7M budget was broken into three categories: Routine Operations & Maintenance, Non-Routine Operations & Maintenance, and Capital Outlay. At the end of the second quarter, 27% of the total annual budget had been expended.

Total Budget	Expenses through Q2	Balance Available	% of Budget Expended
$7,726,013.00	$ 2,055,255.00	$ 5,670,758.00	27%

Routine O&M had a budget of $4.6M. At the end of the second quarter, 43% of the annual budget had been expended, resulting in in approximately $2.64M available for the remainder of the year. Expenses in this category are slightly under budgeted levels.

Total Budget	Expenses through Q2	Balance Available	% of Budget Expended
$4,623,290.00	$1,973,411.00	$2,649,879.00	43%

Non-Routine O&M had a budget of $1.8M. At the end of the second quarter, 3% of the annual budget had been expended, resulting in an available balance of roughly $1.7M for the remainder of the year. Most of the other items in this category have had budget carried forward from the prior year to continue work on them.

Total Budget	Expenses through Q2	Balance Available	% of Budget Expended
$1,812,008.00	$46,273.00	$1,725,735.00	3%

Capital Outlay had a budget of almost $1.29M. At the end of the second quarter, expenses were 3% of the annual budget, resulting in approximately $1.25M available for the remainder of the year. Unspent budget from the prior year has been carried forward for several projects and accounts for the majority of this category's budget.

Total Budget	Expenses through Q2	Balance Available	% of Budget Expended
$ 1,290,715.00	$35,571.00	$1,255,144.00	3%

The agencies involved: City of Arroyo Grande, City of Grover Beach, City of Pismo Beach, Oceano Community Services District, and County Service Area 12. Subcontractors of CSA 12 include Port San Luis Harbor District and Avila Beach Community Services District.

All agencies are current on their 2nd installment payments for the fiscal year 2022-23.

No public comment was given.

VI. Capital Projects Update (Attachment 5 of the Agenda Packet)

A. Tesla Battery Storage

i. Complete; waiting on permit from PG&E to operate.
ii. Budget -- Free

B. Spillway Assessment and Investigation

i. Spill assessment was directed by DSOD after the Oroville incident; completed nondestructive desktop review of the spillway.
ii. Work plan to complete destructive testing is in review.
iii. Remainder of project ~minimum of $300,000

C. Geotechnical Testing & Seismic Alternatives Study of Terminal Reservoir Dam

i. Permit approved; scheduled work to begin in early April.
ii. Budget ~$500,000

D. Cathodic Protection Repair Project

i. Award BOS letter on April 18 to Farwest Corrosion.
ii. Budget ~$449,933

E. CO2 Injection System

i. Awarded to Hartzell Construction; project in process.
ii. Budget ~$256,000

F. Sludge Bed Curtain Wall Rehabilitation

i. No change
ii. ~$50,000 per initial quote

G. Chlorine Dioxide Bulk Storage Tank

i. Tank has been repaired and is in operation.
ii. Budget ~$47,309.51

H. Lopez Water Treatment Plant Rack 1 Membrane Replacement

i. Complete

VII. Action Items (No Subsequent Board of Supervisors Action Required)

A. None

VIII. Action Items (Board of Supervisors Action is Subsequently Required)

A. **Fiscal Year 2023/24 Budget Endorsement –** Member Barneich presented questions asked by her staff:

i. In reference to *Routine O&M Expenditures*, what are the percentage increases for negotiated union wages?
   1. David Spiegel and Megan Schotborgh reported that most people received a 3% increase for the first two years and a 2.5% increase in the third year.

ii. In reference to *Designated Reserves*, when does Zone 3 anticipate these tasks to be completed and how does the 558,000 public safety relate to water quality and quantity purposes?
   1. David Spiegel explained that under District Designated Reserves, $50,000 is for HCP and other designated projects. In the previous advisory meeting, the Committee voted to move all funds to the safety category to be used later. Funds will not be spent until the Committee assigns them to a project.

iii. David Spiegel and Megan Schotborgh clarified that the Terminal Dam Investigation for the Department of Dam Safety and HCP are included in the 2023/24 proposed budget.

iv. In reference to *Reserve Projects*, are the reserves earning interest and is all the interest being put into the operating reserve funds balance?
   1. Megan Schotborgh explained that the interest revenue is going into operating reserves and continues to earn interest. Megan further reported that after speaking to the Treasury Manager, interest rate will increase by 25 basis points two to three times before being cut.

v. In reference to *Cost per Acre Foot*, the Arroyo Grande amount of $2.9M is higher than the projected amount according to a rate study, is it possible to smooth the increase?
   1. Megan Schotborgh explained that the City of Arroyo Grande had a $130,000 increase compared to the previous proposed budget, taking into consideration the actual cost of the fiscal year. Agencies are billed ahead of time and the amount is trued up after actual costs. The actual cost of 2022-23 fiscal year was $3.6M for Arroyo Grande.

vi. No further comments from the Committee. ***Member Barneich entertained motion; Member Guthrie motioned to approve; Second by Member Gibson.*** **Roll call vote.** ***Motion passed.***

B. **Declaration of Surplus Water (Attachment 6 of the Agenda Packet)**

i. David Spiegel explained that any unused entitlement is automatically delivered to agencies' storage accounts. Surplus water is generated only by unused downstream release.

ii. There was 2,100 acre-feet (AF) of surplus water available in total and split among agencies – City of Arroyo Grande at 1,062 AF; City of Pismo Beach at 413 AF; City of Grover Beach at 371 AF; Oceano Community Services District at 140 AF; CSA 12 at 114 AF.

iii. David Spiegel explained that under the new contract, agencies do not purchase surplus water. Instead, they pay variable costs once they take delivery of water.

iv. No further comments from the Committee. ***Member Barneich entertained motion; Member Gibson motioned to approve; Second by Member Guthrie.*** **Roll call vote.** ***Motion passed.***

IX. Future Agenda Items

A. Cloud Seeding Update – Member Guthrie asked for an update on cloud seeding. David Spiegel reported that further cloud seeding cannot be authorized in concerns for public safety, thus the program has been shut down for the season (the season began December 1, 2022 and ends March 31, 2023); a half-month credit for operating costs was reimbursed. The program is expected to resume in December 2023.

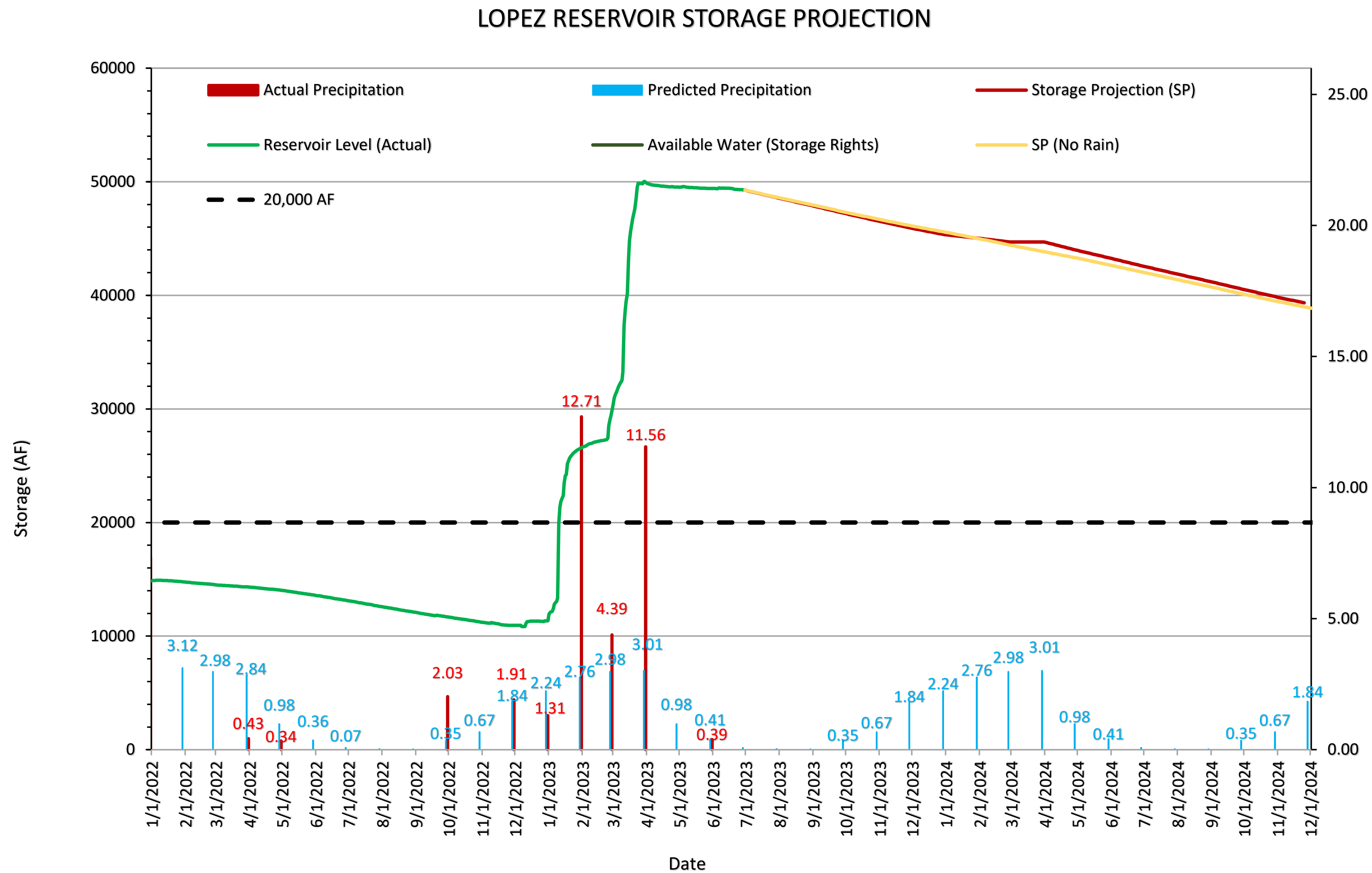
X. Committee Member Comments

A. No further comments.

Meeting Adjourned at 6:59 PM by Kristen Barneich.

Respectfully Submitted,

Vivien Cheung
County of San Luis Obispo Public Works Department



Notes:

Reservoir Storage = Current Storage + Inflow - Outflow

Outflow = Agency Usage + Downstream Releases

Agency Usage: is based on 2010-2021 average monthly deliveries

Predicted Inflow: is dependent on the predicted rainfall obtained from longrangeweather.com

Inflow is affected by antecedant soil conditions and factored into the model. Rainstorms will produce less inflow during the dry months than during the rainy season when the soil is saturated.

The **Storage Projection Model** is based on a polynomial regresssion (concave in shape). The (concave) **Storage Projection Graph** will fall below the (linear) **Storage Projection with No Rain Graph** during months of low predicted rainfall.

San Luis Obispo County Flood Control and Water District
Zone 3 - Lopez Project - Monthly Operations Report
May, 2023

PROJECT WATER

CONTRACTOR	AVAILABLE WATER (APR-MAR) ENTITLE MENT	STORED PW*	TOTAL AVAILABLE PW	DELIVERIES THIS MONTH ENTITLEMENT USAGE	%	STORED PW USAGE	%	TOTAL USAGE	%	APRIL TO PRESENT ENTITLEMENT USAGE	%	STORED PW USAGE	%	TOTAL USAGE USAGE	%
AG	2290.0	0.0	2290.0	171.36	7%	0.0	0.0	171.4	7%	317.6	14%	0.0	0%	317.6	14%
OCSD	303.0	0.0	303.0	53.08	18%	0.0	0.0	53.1	18%	85.0	28%	0.0	0%	85.0	28%
GB	800.0	0.0	800.0	67.17	8%	0.0	0.0	67.2	8%	133.6	17%	0.0	0%	133.6	17%
PB	892.0	0.0	892.0	126.44	14%	0.0	0.0	126.4	14%	241.1	27%	0.0	0%	241.1	27%
CSA 12	245.0	0.0	245.0	8.42	3%	0.0	0.0	8.4	3%	13.1	5%	0.0	0%	13.1	5%
SM	N/A	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	**4530.0**	**0.0**	**4530.0**	**426.47**	**9.4%**	**0.0**	**0.0**	**426.5**	**9.4%**	**790.5**	**17.5%**	**0**	**0.0%**	**790.5**	**17%**

CONTRACTOR	CREDIT TO ENTITLEMENT DUE TO SPILL [AF]
AG	171.36
OCSD	53.08
GB	67.17
PB	126.44
CSA 12	8.42
SM	N/A
TOTAL	**426.47**

STATE WATER PROJECT WATER

CONTRACTOR	ANNUAL REQUEST**	CUMULATIVE SSWPW ***	DELIVERIES THIS MONTH REQUEST	ALLOCATION USAGE	%	DIE USAGE	AIE USAGE	TOTAL USAGE	JANUARY TO PRESENT ALLOCATION USAGE	%	DIE USAGE	AIE USAGE	TOTAL USAGE
AG	N/A	0.0	N/A	N/A	N/A	0.0	0.0	0.0	N/A	N/A	0	0	0.0
OCSD	187.5	0.0	0.0	0.0	0%	0.0	0.0	0.0	94.6	50%	0	0	94.6
GB	N/A	0.0	N/A	N/A	N/A	0.0	0.0	0.0	N/A	N/A	0	0	0.0
PB	310.0	0.0	0.0	0.0	0%	0.0	0.0	0.0	278.5	90%	0	0	278.5
CSA 12	96.0	0.0	8.3	8.29	9%	0.0	0.0	8.3	32.2	33%	0	0	32.2
SM	90.0	0.0	8.0	6.04	7%	0.0	0.0	6.0	28.8	32%	0	0	28.8
TOTAL	**683.5**	**0.0**	**16.3**	**14.3**	**2%**	**0.0**	**0.0**	**14.3**	**434.0**	**63%**	**0**	**0**	**434.0**

CONTRACTOR	TOTAL MONTHLY DELIVERIES [AF]
AG	171.36
OCSD	53.08
GB	67.17
PB	126.44
CSA 12	16.71
SM	6.04
TOTAL	**440.80**

DAM OPERATIONS

	THIS MONTH	YEAR TO DATE	MAX CAPACITY	
LAKE ELEVATION (ft)	522.7	N/A	522.6	
STORAGE [AF]	49406.0	N/A	49200.0	100%
MONTHLY RAINFALL [in] (Annual: July 1- June 30)	0.39	39.94	N/A	
DOWNSTREAM RELEASES [AF]	297.1	1974.5	4200.0	
LAKE TO TERMINAL [AF]	473.2	3257.3	N/A	
SPILLAGE [AF]	1500.2	14284.1	N/A	

DISTRICT STORED SWP WATER

	[AF]
PREVIOUS MONTH	0.0
DWR METER DELIVERIES	0.00
THIS MONTH	0.0
AG WHEELING TO OCEANO	1.54

GLOSSARY

AIE: Agency Initiated Exchange
DIE: District Initiated Exchange
N/A: Not Applicable
PW: Project Water aka Lopez Water
Surplus Water: Carry Over Water (LRRP)
SWP: State Water Project
SSWPW: Stored SWP Water

Notes:

* Stored PW includes Surplus water declared
** Actual Amount available is dependent on the State's (DWR) delivery %
*** Stored SWP water resulting from AIE

1) New Contract Changes effective October 1, 2022
2) On 12/31/22 there was an estimated 655.5 AF of District SSWPW remaining including approximately 46 AF of water lost to evaporation in 2022.
3) In March 2023, 5489 AF of water spilled resulting in loosing all of the District SSWPW, Agency SSWPW, and Stored PW.
4) 44.53 AF of March Project Water Deliveries will be credited to entitlement at the end of the year due to March spill event.
5) 260.70 AF of April Project Water Deliveries will be credited to entitlement at the end of the year due to April spill event.
6) 426.5 AF of May Project Water Deliveries will be credied to entitlement at the end of the year due to May spill event.

San Luis Obispo County Flood Control and Water District
Zone 3 - Lopez Project - Monthly Operations Report
June, 2023

PROJECT WATER

	AVAILABLE WATER (APR-MAR)			DELIVERIES												CREDIT TO ENTITLEMENT DUE TO SPILL
				THIS MONTH						APRIL TO PRESENT						
				ENTITLEMENT		STORED PW		TOTAL		ENTITLEMENT		STORED PW		TOTAL USAGE		
CONTRACTOR	ENTITLE MENT	STORED PW*	TOTAL AVAILABLE PW	USAGE	%	USAGE	%	USAGE	%	USAGE	%	USAGE	%	USAGE	%	[AF]
AG	2290.0	0.0	2290.0	168.10	7%	0.0	0.0	168.1	7%	485.7	21%	0.0	0%	485.7	21%	87.44
OCSD	303.0	0.0	303.0	53.33	18%	0.0	0.0	53.3	18%	138.4	46%	0.0	0%	138.4	46%	11.57
GB	800.0	0.0	800.0	62.70	8%	0.0	0.0	62.7	8%	196.3	25%	0.0	0%	196.3	25%	30.55
PB	892.0	0.0	892.0	129.73	15%	0.0	0.0	129.7	15%	370.8	42%	0.0	0%	370.8	42%	34.06
CSA 12	245.0	0.0	245.0	6.97	3%	0.0	0.0	7.0	3%	20.1	8%	0.0	0%	20.1	8%	6.97
SM	N/A	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	**4530.0**	**0.0**	**4530.0**	**420.83**	**9.3%**	**0.0**	**0.0**	**420.8**	**9.3%**	**1211.3**	**26.7%**	**0**	**0.0%**	**1211.3**	**27%**	**170.59**

STATE WATER PROJECT WATER

			DELIVERIES										
			THIS MONTH						JANUARY TO PRESENT				
				ALLOCATION		DIE	AIE	TOTAL	ALLOCATION		DIE	AIE	TOTAL
CONTRACTOR	ANNUAL REQUEST**	CUMULATIVE SSWPW ***	REQUEST	USAGE	%	USAGE	USAGE	USAGE	USAGE	%	USAGE	USAGE	USAGE
AG	N/A	0.0	N/A	N/A	N/A	0.0	0.0	0.0	N/A	N/A	0	0	0.0
OCSD	187.5	0.0	0.0	0.0	0%	0.0	0.0	0.0	94.6	50%	0	0	94.6
GB	N/A	0.0	N/A	N/A	N/A	0.0	0.0	0.0	N/A	N/A	0	0	0.0
PB	1070.0	0.0	0.0	0.0	0%	0.0	0.0	0.0	278.5	26%	0	0	278.5
CSA 12	96.0	0.0	8.5	8.29	9%	0.0	0.0	8.3	40.4	42%	0	0	40.4
SM	90.0	0.0	8.0	4.04	4%	0.0	0.0	4.0	32.8	36%	0	0	32.8
TOTAL	**1443.5**	**0.0**	**16.5**	**12.33**	**1%**	**0.0**	**0.0**	**12.3**	**446.3**	**31%**	**0**	**0**	**446.3**

CONTRACTOR	TOTAL MONTHLY DELIVERIES [AF]
AG	168.10
OCSD	53.33
GB	62.70
PB	129.73
CSA 12	15.26
SM	4.04
TOTAL	**433.16**

DAM OPERATIONS

	THIS MONTH	YEAR TO DATE	MAX CAPACITY	
LAKE ELEVATION (ft)	522.47	N/A	522.6	
STORAGE [AF]	49268	N/A	49200	100%
MONTHLY RAINFALL [in] (Annual: July 1- June 30)	0.39	40.33	N/A	
DOWNSTREAM RELEASES [AF]	378.09	2352.6	4200.0	
LAKE TO TERMINAL [AF]	573.9	3831.2	N/A	
SPILLAGE [AF]	172.97	14457.1	N/A	

DISTRICT STORED SWP WATER

	[AF]
PREVIOUS MONTH	0.0
DWR METER DELIVERIES	5.00
THIS MONTH	0.0
AG WHEELING TO OCEANO	1.61

GLOSSARY

AIE: Agency Initiated Exchange
DIE: District Initiated Exchange
N/A: Not Applicable
PW: Project Water aka Lopez Water
Surplus Water: Carry Over Water (LRRP)
SWP: State Water Project
SSWPW: Stored SWP Water

Notes:

* Stored PW includes Surplus water declared
** Actual Amount available is dependent on the State's (DWR) delivery %
*** Stored SWP water resulting from AIE

1) New Contract Changes effective October 1, 2022
2) On 12/31/22 there was an estimated 655.5 AF of District SSWPW remaining including approximately 46 AF of water lost to evaporation in 2022.
3) In March 2023, 5489 AF of water spilled resulting in loosing all of the District SSWPW, Agency SSWPW, and Stored PW.
4) 44.53 AF of March Project Water Deliveries will be credited to entitlement at the end of the year due to March spill event.
5) 260.70 AF of April Project Water Deliveries will be credited to entitlement at the end of the year due to April spill event.
6) 426.5 AF of May Project Water Deliveries will be credied to entitlement at the end of the year due to May spill event.
7) 170.59 AF of June Project Water Deliveries will be credied to entitlement at the end of the year due to June spill event.

LAFCO - San Luis Obispo - Local Agency Formation Commission

SLO LAFCO - Serving the Area of San Luis Obispo County

March 21, 2023 **SENT VIA E-MAIL**

Applicant/Agents:

Art Weldon | art.weldon@icloud.com
Perry McBeth | pmcbeth@garingtaylor.com

Subject: Sphere of Influence Amendment and Annexation #4 to County Service Area 12 (Weldon) | LAFCO File No. 1-R-23

Dear Applicant,

This letter is to advise you that the application for Sphere of Influence Amendment and Annexation #4 to County Service Area 12 (Weldon) was officially received on February 21, 2023, and was referred to other agencies involved in the process. LAFCO staff have completed an initial 30-day review of the application and find that the following items need to be submitted for LAFCO to continue processing the application. Due to the issues identified below, staff recommend that a coordination meeting via Zoom be arranged to discuss the items in further detail once you have had an opportunity to review this letter. Our intent is to help the petitioners achieve their goals to annex into CSA 12, we look forward to further coordination.

1. Please be advised, as noted in our February 6, 2023 email, that this project was not referred by County Planning & Building to LAFCO during the entitlement process nor was the CEQA document sent to LAFCO for review as a Responsible Agency. As such, there are comments below that may have significant implications as they relate to this annexation request. Additionally, while we have conducted a preliminary review of the MND, we are not certain, particularly depending on the issues identified below, whether we can rely upon the County's MND for the discretionary action required of LAFCO to approve this annexation. Further details on this matter are discussed below.

2. We understand that the request submitted in the application is for the entire 166-acre area, however such a proposal could have significant implications for environmental review under CEQA, as well as result in inconsistencies with LAFCO policies and regulations.

   In brief, regarding CEQA, the proposed area of annexation is not consistent with the analysis of the MND. More specifically, the MND prepared by the County evaluates and assumes that development would occur on the ~2.5 acre building envelopes. The intent to annex into a CSA is to provide urban services (in this circumstance water supply) to a given area or legal parcel(s). Should the entire 166-acre area be annexed into

CSA 12, areas outside of the building envelopes could obtain urban service from CSA 12 and therefore support urban development beyond the established building envelope and beyond the areas analyzed in the MND. Additionally, because the site is zoned Rural Lands, it could allow for a wide range of land uses. Annexing the entirety of the parcel therefore has implications that were not analyzed in the MND. Should you wish to annex the entirety of the parcel, it would require additional environmental review to understand the impacts of allowing urban services beyond the County-defined building envelopes and in context to allowable uses within Rural Lands zoning. To ensure consistency with the MND, the annexation area would need to be limited to the building envelopes.

Related to this matter, it appears the site contains prime agricultural soils within the development area. Can you please confirm whether any agricultural activities have occurred on the project site at any point in time?

Regarding LAFCO policies, as stated in our February 6, 2023, email, when a building envelope is established the annexation area is limited to the building envelope. The primary reason is that the need for urban services only can possibly occur within the building envelope. An annexation of the entire parcel would not be supportable in context to regulatory requirements (gov code 56668 (b)), existing SLO LAFCO policies, and Commission precedent.

Altogether, staff recommends the applicant modify their application to only include the area within the building envelopes where development would occur.

3. Please provide us a signed copy of the Notice of Determination and the Environmental Filing Fee Cash Receipt that was filed with the County Clerk for subdivision (Weldon Parcel Map ED20-179 SUB2015-00070). We need this to file the CEQA documentation as Responsible agency, should we be able to rely upon the CEQA documentation prepared for this entitlement.

4. In line with our previous recommendation, should the chosen outcome be to limit the annexation area to the building envelopes, please submit a map and legal description which reflects the new proposed annexation area. Map and legal discrepancies will have to be continuously corrected until the County Surveyor determines the map and legal description to be definite and certain. After it has been determined to be definite and certain LAFCO will need; four (4) copies of the maps and legal descriptions signed and stamped by Registered Civil Engineer or a Licensed Land Surveyor. The maps shall be sized at a maximum of 24” x 36” and a minimum of 18” x 26” with a minimum ½” border. For more information on the standards for the maps and legal descriptions, please refer to the LAFCO Proposal Application on the LAFCO website.

5. A plan for providing services, prepared by CSA 12, i.e. the County, needs to be submitted. The plan shall include the information outlined under gov code section 56653. Please coordinate with County Public Works if you have any questions about the Plan for Services requirements. The Public Works point of contact for this project is Francesca Devlin, fdevlin@co.slo.ca.us

6. Please confirm that the *final* map for Weldon Parcel Map ED20-179 SUB2015-00070 has been approved by the County. If so, please provide a copy.

7. Please submit a LAFCO Cost Accounting Agreement form (available on the LAFCO website at slo.lafco.ca.gov) signed by the landowner.

8. A letter of consent from each affected property owner is required if the application is to waive the protest process. Please use the consent letter example in our application. Additionally, please specifically state that the property referenced includes 100% consent from landowners in the project area.

9. Please provide the Water Delivery Contract with CSA 12 dated November 1, 2016.

10. As with all petition-initiated annexations, there are specific processes that must be followed and notification to the applicable agency is required. At the next LAFCO public meeting on April 20, 2023, a notice per gov code section 56857 (b) will be provided to the Commission as an informational item only. The intent of this item is only to notify the Commission of receipt of this petition for annexation – no action or discussion will occur beyond the notice. This notice is also sent to CSA 12. Upon April 20, 2023, CSA 12 will have 60 days to submit a resolution to LAFCO requesting the annexation application be terminated as set forth in the code section. If no resolution is received, LAFCO will continue to process the application. It is not anticipated that CSA 12 will have any concerns or wish to terminate the application because they have already provided a conditional intent to serve. Nonetheless, this process is required by law to be conducted.

11. As required by law, a Negotiated Property Tax Agreement is required to be approved by resolution by the Board of Supervisors even if it is a neutral exchange. This is a required step and involves the County Auditor/Assessor and the State Board of Equalization. This process adjusts the Tax Rate Areas due to the boundary changes of the District. This process must be completed before the application can be considered by the Commission as required by gov code section 56810. LAFCO initiates and completes the process on your behalf. The Board of Supervisors approves the agreement. We have already submitted the information to the County Auditor/Assessor, and we will inform you of the Board of Supervisors date when the Administrative Office provides such information.

12. As stated in the LAFCO proposal application, there is a fee associated with filing with the State Board of Equalization (BOE). This would require a separate check made out to the State Board of Equalization. For an area between 1.00-acres and 5.99-acres the fee would be $350. A check would only be needed if the LAFCO Commission approves the proposal; the check should be submitted to LAFCO to be included with the BOE filing packet.

This is not a comprehensive list of what may be necessary to process this application. Other information needs or questions may arise as our review of the application continues. If you have any questions, please contact us at 805.781.5795 or email mbing@slo.lafco.ca.gov.

Sincerely,

____

Morgan Bing, LAFCO Clerk Analyst

cc. Rob Fitzroy, LAFCO Executive Officer
LAFCO Counsel, Brian Pierik

Annual Cloud Seeding Report

Lake Lopez Watershed

2022-2023 Winter Season

Prepared For:

County of San Luis Obispo,

Department of Public Works

Prepared By:

David Yorty

North American Weather Consultants, Inc.

8180 S. Highland Dr., Suite B-2

Sandy, Utah 84093

June 2023

NAWC INC

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EXECUTIVE SUMMARY

For the 2022-2023 winter season, cloud seeding operations were conducted to enhance precipitation in the Lopez Lake drainage in San Luis Obispo County. A ground-based seeding location (Arroyo Grande) was utilized specifically for this area. Seeding was also conducted from other sites when conditions were favorable, including Mt. Lospe and Berros Peak. The formal operational period began December 1, 2022 and ended March 31, 2023. However, the seeding program was suspended following a very heavy rainfall event on January 9. Although there were discussions about possible seeding operations later in the season, the program remained suspended as flooding concerns continued during subsequent storm events through the remainder of the season.

The cloud seeding equipment used in this program is of a proprietary design and uses high output cloud seeding flares. The ground-based equipment is designed to be operated remotely via cellular link. This equipment was designed specifically for cloud seeding operations on the California coastline, where storms are characterized by high values of supercooled liquid water. An aircraft was added to the program this season, beginning in January. Operations for the project were directed by David Yorty, a NAWC meteorologist, who is a certified weather modification manager by the Weather Modification Association (WMA). Todd Flanagan was an alternate meteorologist for the program. Coordination of all seeding activities was maintained with Mr. David Spiegel with the County of San Luis Obispo Department of Public Works.

As with the two previous seasons, the ENSO (El Niño-Southern Oscillation) phase was classified as a La Niña again during the 2022-2023 winter season. Precipitation in San Luis Obispo County and around the rest of the Central Coast, however, was far above normal with this being one of the wettest seasons on record. As of April 30, precipitation totals were well over 200% of the normal water year totals at most sites in and near the Lopez Lake target area. Rainfall from the beginning of the water year (September 1, 2022) through April 2023 is summarized in Table E-1.

Table E-1
2022-2023 Monthly Precipitation (Inches)
For Locations near the Lopez Lake Target Area

Location	December	January	February	March	April	Water Year to Date as of Apr 30	Percent of normal WY Total
Arroyo Grande Creek	7.64	7.88	5.13	8.43	0.01	32.74	182%
Davis Peak	9.22	9.02	4.69	11.94	NA	37.74	210%
Lopez Dam	10.59	12.88	5.89	12.99	0.00	47.23	239%
Salinas Dam	13.08	15.60	7.45	11.59	0.00	50.71	232%
Santa Margarita	11.02	15.03	6.85	11.55	0.00	47.25	199%
SLO Reservoir	13.19	15.66	5.52	15.28	0.02	52.18	220%
Upper Lopez	11.63	11.86	5.71	15.71	0.00	49.68	228%

Climate Overview

Every ten years, the National Oceanic and Atmospheric Association (NOAA) releases a summary of various U.S. weather conditions for the past three decades to determines average values for a variety of conditions, including, temperature and precipitation. This is known as the U.S Climate normal, with a 30-year average representing the current averages for the climate. These 30-year normal values can help to determine a departure from historic norms and identify current weather trends.

The current 30-year average is based on the 1990 – 2020 period. Images in Figures E1 and E2 show how each 30-year average for the past 120 years compares to the composite 20th century average for temperature and precipitation.

For the western U.S., the 1990-2020 averages were quite warm in comparison to the 100-year 20th century average. When comparing precipitation for the past 30 years to both the previous 30-year average and the 1901-2000 average, the American Southwest (including portions of Utah, Arizona, California and Nevada) has seen as much as a 10% decrease in average annual precipitation.

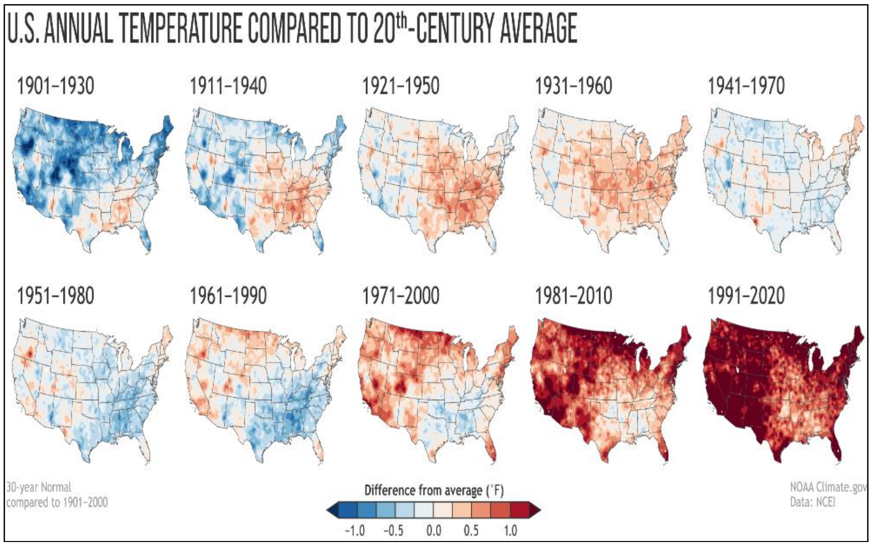

Figure E1 **U.S. Annual Temperature compared to 20th-Century Average**

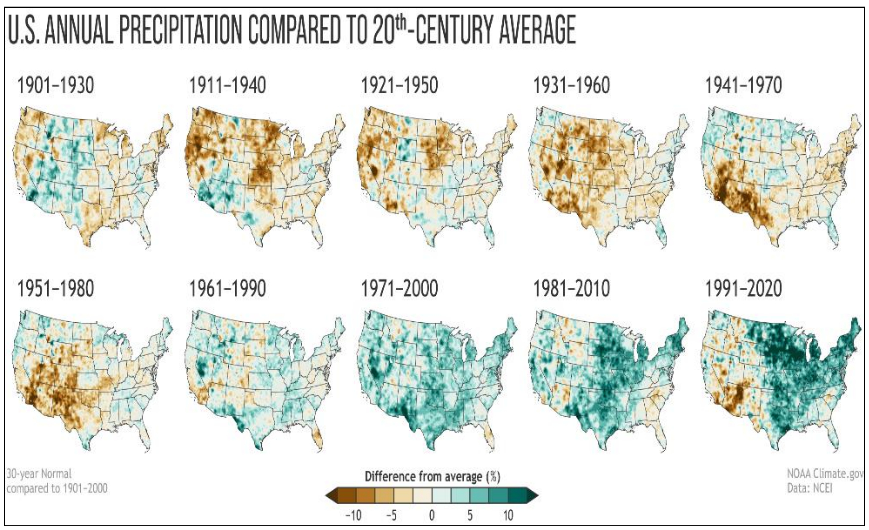

Figure E2 **U.S. Annual Precipitation compared to 20th-Century Average**

Cloud Seeding Overview

Seeding opportunities occurred on six calendar days during the 2022-2023 operational season. Five of these were in December, with one additional seeded event in early January before the program was suspended. A total of 28 flares were successfully burned to target the Lopez Lake watershed, releasing an estimated 420 grams of AgI. Most of these were ground-based flares, although there were five burned from the seeding aircraft in a January 5 seeded event.

1. INTRODUCTION

1.1 Program History

North American Weather Consultants (NAWC) conducted its first season of cloud seeding operations during the 2019-2020 winter season with the County of San Luis Obispo Department of Public Works. The Agency issued a Request for Proposals (RFP) on September 16, 2019 for a cloud seeding program of up to three seasons duration. NAWC was awarded this contract on December 17, 2019. NAWC, with headquarters in Sandy, Utah, was contracted this most recent season for a four-month cloud seeding program for the Agency from this current season from December 1, 2022 through March 31, 2023. Although NAWC's original proposal included both airborne and ground-based seeding, the ground-based portion of the program has been utilized more frequently than aircraft due to budgetary constraints.

For the 2022-23 season, ground-based seeding was conducted from the Arroyo Grande site as well as the seeding aircraft. The Arroyo Grande site (as well as other site availably when conditions are appropriate) has a Automated High Output Ground Seeding (AHOGS) system. These systems use flares with high concentrations of silver iodide, dispersed through remote means (cellular data connection) to introduce seeding agents into storm systems.

Seasonal Weather Summary

The ENSO (El Niño-Southern Oscillation) phase was classified as a La Niña once again during the 2022-2023 winter season. Despite the La Niña pattern typically being implicated in below normal precipitation for this portion of California, this season was abnormally wet and stormy with over 200% of the normal water year precipitation totals at most sites. Table 1-1 shows precipitation amounts from several stations in San Luis Obispo County.

Table 1-1
2022-2023 Monthly Precipitation (Inches)
For Locations near the Lopez Lake Target Area

Location	December	January	February	March	April	Water Year to Date as of Apr 30	Percent of normal WY Total
Arroyo Grande Creek	7.64	7.88	5.13	8.43	0.01	32.74	182%
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Upper Lopez	11.63	11.86	5.71	15.71	0.00	49.68	228%

Figure 1.1 is a drought monitor comparison for April 2022 vs. April 2023. This shows the recovery from extreme drought to near normal water conditions more recently.

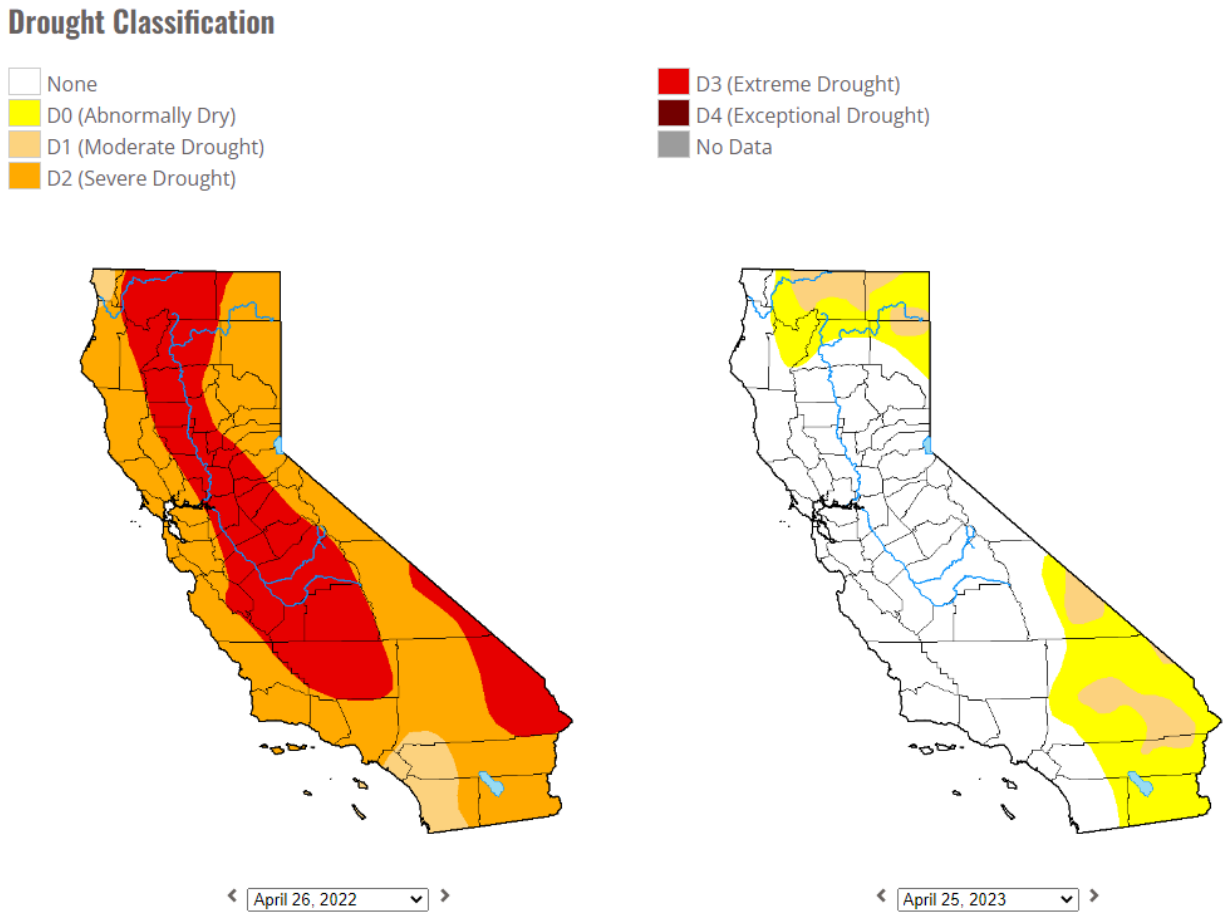

Figure 1.1 U.S. Drought Monitor Conditions for California for April 26, 2022 (left) and April 25, 2023 (right)

1.2 Report Terms and Acronyms

Table 1-2
Project Acronyms and Descriptions

Acronym	Description	Acronym	Description
AHOGS System	Automated High Output Ground Seeding System	NCAR	National Center for Atmospheric Research
ALERT Network	Automated Local Evaluation in Real Time Network	NOAA	National Oceanic and Atmospheric Association
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory (Model)	READY	Real-Time Environmental Applications and Display System
AFB	Air Force Base	ICE	Ice Crystal Engineering
AFWA	Air Force Weather Agency	NAWC	North American Weather Consultants
FAA	Federal Aviation Administration	NEXRAD	Next Generation Radar
ARL	Air Resources Laboratory	NWS	National Weather Service
CSU	Colorado State University	PDT	Pacific Daylight Time
ENSO	El Nino Southern Oscillation	PST	Pacific Standard Time
FACE	Florida Area Cumulus Experiment	SBCWA	Santa Barbara County Water Agency
FSL	Forecast System Laboratory	SLW	Supercooled Liquid Water
HRRR	High Resolution Rapid Refresh	WMA	Weather Modification Association
GMT	Greenwich mean time	WRF	Weather Research and Forecasting

2. CLOUD SEEDING RESEARCH AND MECHANISMS

Two scientific mechanisms have been described concerning the potential to augment precipitation with cloud seeding. One of these involves increasing an individual cloud's efficiency in producing precipitation, while another potential (resultant) effect of this is the enhancement of cloud development in the individual cloud or within the larger system, leading to additional precipitation. The first mechanism has often been referred to as the *static* seeding hypothesis, while the second relies upon *dynamic* effects of cloud growth. In many situations, both processes could be operative, whereby a cloud's precipitation efficiency is increased, and the cloud is made to grow larger due to seeding.

Clouds contain water vapor, water droplets and frequently ice crystals if cloud temperatures drop below freezing. Discoveries in the late 1940's established that microscopic particle of silver iodide cause supercooled water droplets to freeze (Vonnegut, 1947). Moisture in a cloud deck will remain aloft unless it congregates and forms snowflakes that are heavy enough to overcome the storms natural updrafts. Pure water can remain liquid and therefore suspended in a cloud deck until temperatures as cold as -17^{o}C. Silver iodide can speed up this process of freezing, congregating, forming a snowflake and falling as precipitation, by acting as a catalyst for the freezing of liquid water well above -17^{o}C. Through this process, silver iodide can therefore enhance a storms natural productivity by making the snowflake formation process more efficient. These supercooled water droplets are the normal targets of most present-day cloud seeding programs. More on this in future sections.

2.1 Precipitation Processes

There are two basic mechanisms that produce precipitation: collision-coalescence and ice formation. The collision-coalescence process is defined as the growth of raindrops by the merging and/or colliding of cloud drops and small precipitation particles. This process is especially important for the rainfall process in tropical climates, but it can also be a factor in the formation of rainfall in more temperate climates like those found in San Luis Obispo County. Ice formation or nucleation, as described in the Bergeron-Findeisen theory, consists of a process in which precipitation particles may form within a mixed cloud, which is one composed of both ice crystals and liquid water drops. In such clouds the ice crystals can gain mass by deposition (water vapor turning directly to ice) at the expense of the liquid drops surrounding the ice crystals, by accumulation of these water drops (riming). Upon attaining sufficient weight, the ice crystal would typically fall to the ground as snow if the surface temperatures are at or below freezing, or melt and fall as raindrops if the surface temperatures are warmer than freezing. This Bergeron-Findeisen process is important in the production of snow and rain in more temperate climates like those found in San Luis Obispo County. The presence of supercooled water droplets in clouds is usually the focus of cloud seeding efforts.

2.2 Ice Nucleation

As discussed in the previous section, clouds often contain liquid cloud droplets at sub-freezing temperatures. These droplets are termed supercooled. The natural tendency is for these droplets to freeze, but to do so at temperatures warmer than -39°C they need to encounter an impurity. There are a variety of particles present in the atmosphere that possess the ability to cause these supercooled droplets to freeze. In this context, these particles are known as freezing nuclei or ice nuclei. Research has demonstrated that certain types of natural particles (for example, dust or salt particles, and even a certain type of bacteria) in the atmosphere often serve as freezing nuclei. The conversion of a supercooled water droplet into an ice crystal is referred to as nucleation. It is known that the nucleating efficiency of these naturally occurring freezing nuclei increases with decreasing temperatures. It has also been established that naturally occurring freezing nuclei active in the temperature range of approximately -5 to -15°C are relatively rare. Research has also shown that minute (microscopic) particles of silver iodide begin to act effectively as freezing nuclei at temperatures colder than -5°C (Dennis, 1980). Some more recently developed seeding formulations show nucleation at temperatures as warm as -4°C. Silver iodide is the agent most commonly used to seed clouds when relying on the ice nucleation process.

There are two types of ice nucleation: condensation-freezing and contact. In condensation freezing, a nucleus first serves as a condensation nucleus in forming a cloud droplet. At temperatures of approximately -5°C or colder these same nuclei can serve as freezing nuclei. In other words, under the right conditions, a nucleus can a) aid condensation, forming a cloud droplet and b) then promote freezing on the same nucleus, forming an ice crystal. Contact nucleation, as the name implies, means that a freezing nucleus must come in physical contact with a supercooled cloud droplet, thus causing it to freeze if the temperature of the cloud droplet is cold enough for the freezing nuclei to be active. Contact nucleation can be a relatively slow process compared to condensation-freezing nucleation, which can be quite rapid, on the order of one to a few minutes.

2.3 Impacts of Silver Iodide Seeding

Since a scarcity of natural ice nuclei commonly exists in the atmosphere at temperatures in the range of -5 to -15°C, many clouds may be inefficient in converting water droplets into ice crystals. The addition of silver iodide nuclei to these cloud regions can produce additional ice crystals, which, under the right conditions, grow into snowflakes and fall out of the cloud as either snow or rain. Rain is produced by the melting of such snowflakes when they fall through warmer air near the ground. This increase in efficiency is usually referred to as a *static* seeding effect.

In the process of converting supercooled cloud droplets into ice crystals, additional heat is added to the cloud due to the release of the latent heat of fusion. This additional heat may increase the buoyancy of air within the clouds, resulting in a *dynamic* effect. This postulated *dynamic* effect was the basis for a National Oceanic and Atmospheric Association (NOAA) research program conducted in Florida known as the Florida Area Cumulus Experiment (FACE). Two different phases of FACE 1, 1970-76 and FACE 2, 1978-80 (Woodley et al., 1983) indicated increases in area-wide rainfall, but results fell short of strict statistical acceptance criteria. Rainfall increases from seeded convection bands in the Santa Barbara II research program (Brown et al., 1974) were attributed to both *static* and *dynamic* effects. NAWC conducted this research program in Santa Barbara County with funding from the Naval Weapons Center at China Lake.

2.4 Santa Barbara II Research Program

There was an early research program conducted in Santa Barbara County, termed Santa Barbara I, which was conducted from 1957-1960 and was sponsored by various organizations including the State of California, The University of California, Santa Barbara and Ventura counties, the National Science Foundation, the U.S. Weather Bureau, and the U.S. Forest Service. This program employed randomized seeding during storm periods using ground-based silver iodide nuclei generators. Results from this research program suggested precipitation increases of 45% in some areas but were not statistically significant. Further information about this program can be found in Appendix A of this report.

A second research program conducted in the county was known as the Santa Barbara II program, which was conducted during the winter seasons of 1967 to 1973. Santa Barbara II was conducted in two primary phases. Phase I consisted of the release of silver iodide from a ground site located near 2,600 feet MSL in the Santa Ynez Mountains northwest of Santa Barbara. These silver iodide releases were made as convection bands passed overhead. The releases were conducted on a random seed or no-seed decision basis in order to obtain baseline non-seeded, natural, rainfall information for comparison. A large network of recording precipitation gauges was installed for the research program (Figure 2.1). The amount of precipitation that fell from each seeded or non-seeded convection band was determined at each precipitation gauge location. Average convection band precipitation for seeded and non-seeded events was calculated for each rain gauge location. Figure 2.2 shows the results of seeding from the ground as contours of the ratios of average seeded band precipitation to the non-seeded band precipitation.

Ratios greater than 1.0 are common in Figure 2.2. A ratio of 1.50 would indicate a 50 percent increase in precipitation from seeded convection bands. The increase was shown to be statistically significant in this study, unlike in Santa Barbara I. The reasoning for the difference in statistical significance between these studies can be found in Appendix B. The high ratios in southwestern Kern County are not significant in terms of amounts of additional rainfall since the convection bands (both seeded and non-seeded) rapidly lose intensity as they enter the San Joaquin Valley. In other words, even a relatively high percentage increase applied to a low base amount does not yield much additional precipitation. These apparent effects may be due to delayed ice nucleation (compared to other seeding methods), which would be expected with the type of seeding flares used in this experiment which operated by contact nucleation, a relatively slow process.

The low amounts of natural precipitation in southwest Kern County results from evaporation in downslope flow in the winter storms that affect this area. Such predominant downslope flow areas are frequently known as rain-shadow areas in the lee of mountain ranges. Figure 2.3 dramatically exhibits this feature from the coastal mountains in Central and Southern California, which are wet, to the San Joaquin and Imperial Valleys, which are relatively dry. The 1.5 ratios along the backbone of the Santa Ynez Mountains are, however, significant in terms of rainfall amounts since this area receives higher natural precipitation during winter storms due to upslope flow. This upslope flow is also known as an orographic effect and accounts for many mountainous areas in the west receiving more precipitation than adjoining valleys, especially downwind valleys. It was concluded that convection band precipitation was increased over a large area using this ground-based seeding approach.

In a similar experiment, Phase II employed an aircraft to release silver iodide (generated by silver iodide - acetone wing tip generators) into the convection bands as they approached the Santa Barbara County coastline west of Vandenberg Air Force Base. The convection bands to be seeded were also randomly selected. Figure 2.4 provides the results. Again, a large area of higher precipitation amounts is indicated in seeded convection bands compared to non-seeded convection bands. Notice the westward shift of the effect in this experiment versus the ground-based experiment. This result is physically plausible since the aircraft seeding was normally conducted off the coastline in the vicinity of Vandenberg Air Force Base (for example, west of the ground-based release point), which is further upwind. Material released from the ground also takes some amount of time to reach the -5°C level in cloud, depending on vertical mixing of the atmosphere.

A study of the contribution of convection band precipitation to the total winter precipitation in Santa Barbara County and surrounding areas was conducted in the analysis of the Santa Barbara II research program. This study indicated that convection bands contributed approximately one-half of the total winter precipitation in this area (Figure 2.5). If it is also assumed that all convection bands could be seeded in a given rainy season and that a 50 percent increase was produced, the result would be a 25 percent increase in total rainy season precipitation when these assumptions are correct (although this could be a somewhat optimized situation). Two NAWC reports (Thompson et al., 1988 and Solak et al., 1996) provided a more precise quantification of the optimal seasonal seeding increases that might be expected at Juncal and Gibraltar Dams of 18-22%, respectively, from seeding convection bands.

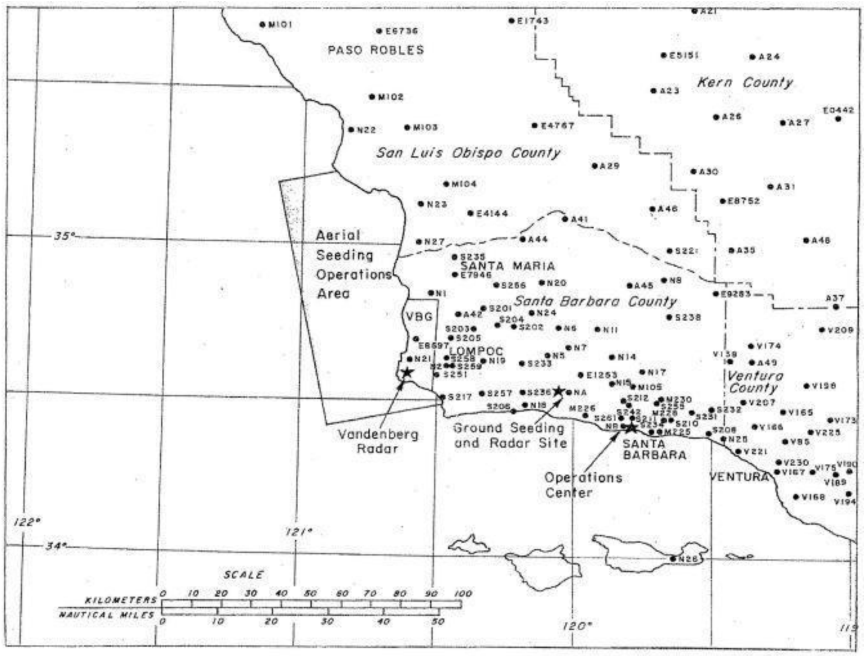

Figure 2.1 **Santa Barbara II project map with rain gauge locations, radar and seeding sites.**

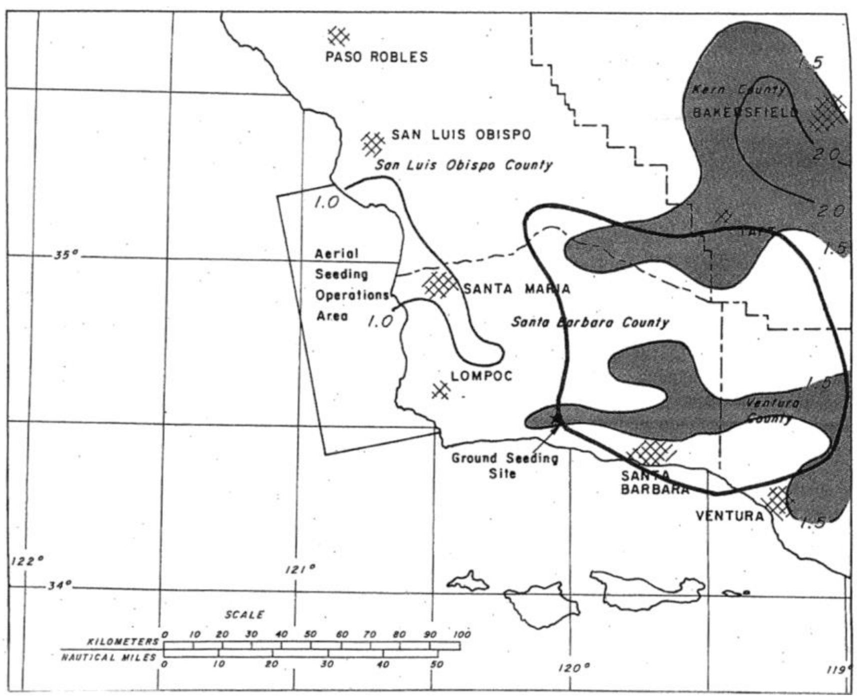

Figure 2.2 **Seeded/Not-Seeded Ratios of band precipitation for Phase I.**

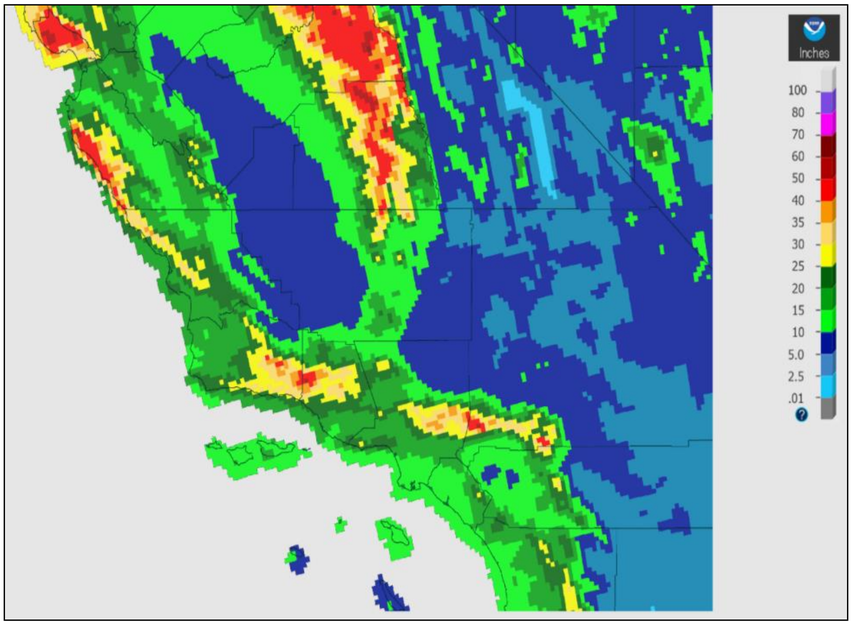

Figure 2.3 Annual average precipitation (inches), Southern California 1980-2010.

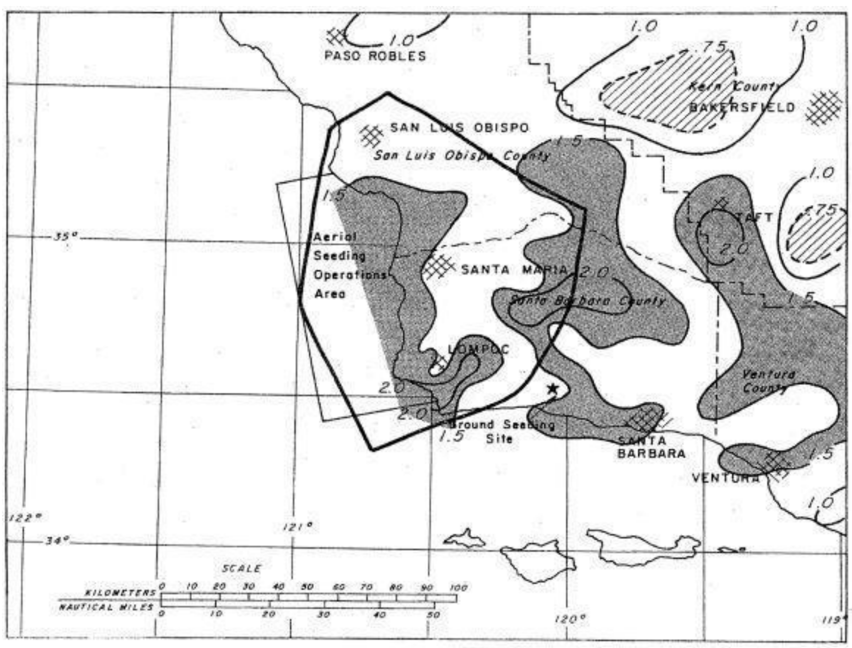

Figure 2.4 Seeded/Not-Seeded ratios of band precipitation for Phase II aerial operations, 1970-74 seasons.

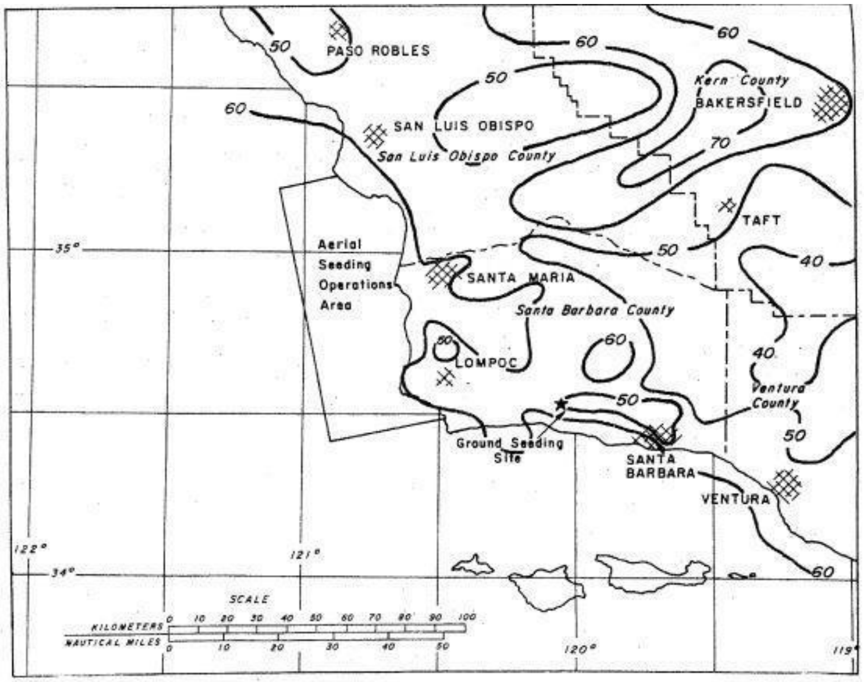

Figure 2.5 **Approximate percentage of winter precipitation occurring in convection bands, 1970-74 seasons.**

In summary, earlier research conducted in Santa Barbara County indicated that convective bands are a common feature of winter storms that impact Santa Barbara County and that those bands contribute a significant proportion of the rainy season precipitation. In addition, research has indicated that these bands contain supercooled liquid cloud droplets, the target of most modern-day cloud seeding activities (Elliott, 1962). Seeding these bands with silver iodide either from the ground or air increases the amount of precipitation received at the ground. These bands are typically oriented in a general north to south fashion (for example, northeast to southwest, northwest to southeast) as they move from west to east. It is common to have at least one convective band per winter storm with as many as three or four per storm on occasion. One band is usually associated with a primary cold frontal passage through the county. Frequently, these frontal bands are the strongest, longest-lasting bands during the passage of a storm. Other bands may occur in either pre-frontal or post-frontal situations. The duration of these bands over a fixed location on the ground can vary from less than one hour to several hours.

In summary, early research conducted in Santa Barbara County indicated that convective bands are a common feature of winter storms that impact this region and that those bands contribute a significant proportion of the rainy season precipitation. In addition, research has indicated that these bands contain supercooled liquid cloud droplets, the target of most modern-day cloud seeding activities (Elliott, 1962). Seeding these bands with silver iodide either from the ground or air increases the amount of precipitation received at the ground. These bands are typically oriented in a general north to south fashion (for example, northeast to southwest, northwest to southeast) as they move from west to east. It is common to have at least one convective band per winter storm with as many as three or four per storm on occasion. One band is usually associated with a primary cold frontal passage through the county. Frequently, these frontal bands are the strongest, longest-lasting bands during the passage of a storm. Other bands may occur in either pre-frontal or post-frontal situations. The duration of these bands over a fixed location on the ground can vary from less than one hour to several hours.

3. PROGRAM DESIGN

The winter cloud seeding program is conducted for the Lopez Lake watershed in San Luis Obispo County. The target area and available seeding sites are depicted in Figure 3.1. The objective of the program was to seed all suitable storm systems affecting the target area that contained convective bands or other seedable cloud features, unless precluded by previously established suspension criteria as discussed in Section 5.0.

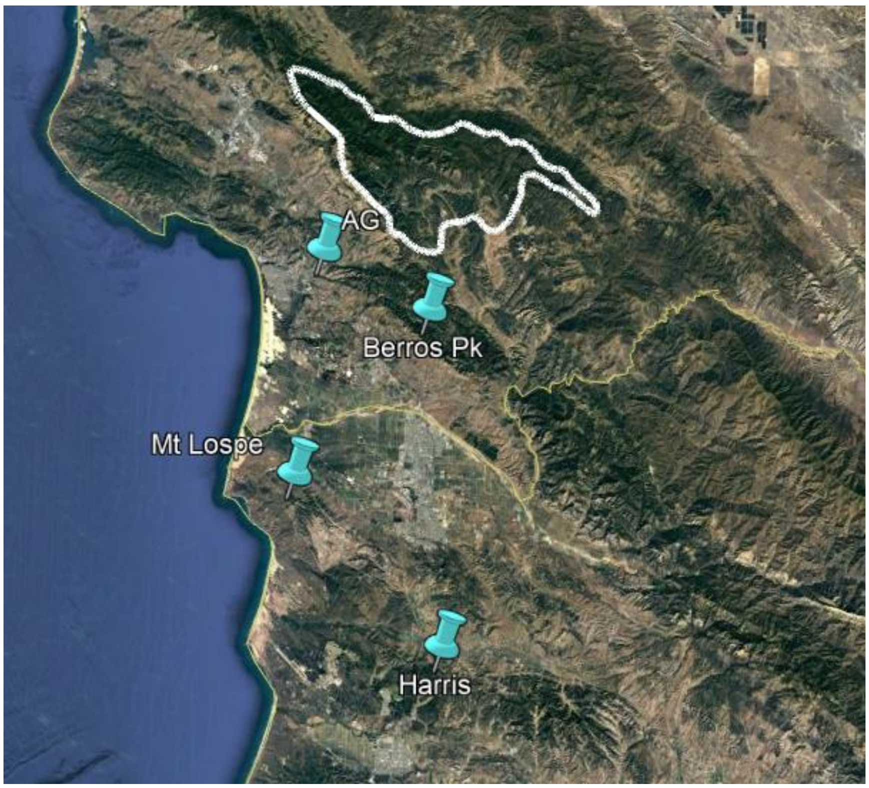

Figure 3.1 **Project area and ground-based high-output flare site locations that were used for the Lopez Lake target during the 2021-2022 season**

Some generalized seeding criteria that NAWC uses to help determine whether an approaching storm contains suitable conditions for seeding.

- Organized storm, with the primary target storms that consist of convective bands.
- 700 mb (approximately 10,000 feet) temperature near to below about -5°C for ground-based seeding.
- 700 mb wind directions favorable for transporting seeding materials over the target areas.
- No suspension criteria met that would prohibit safe operations.

It has always been NAWC's philosophy that the d esign of our operational programs should be based upon prior research programs that provided positive indications of increases in precipitation, to the extent that the research results are considered to be representative of the operational programs' condit ions (this assumes research results from one location are transferable to the operational program's target area).

As a result of the research described in section 2 of this report, NAWC believes the best program design for a winter cloud seeding program in Santa Barbara County and southern San Luis Obispo County to be one that relies primarily on an effective ground strategy, paired to, when funding allows, a comprehensive areal program.

The development of AHOGS for this, and other California programs, came in an effort to maximize the effectiveness of ground-based seeding for program areas where high yield and highly convective coastal storms are present. The AHOGS allow NAWC to use the same high concentration dispersion flares (previously only used on the wings of planes), from the ground. This combines the financial efficiency of ground-based operations with the operational effectiveness of high output seeding methods.

4. EQUIPMENT, PROCEDURES AND PERSONNEL

Each operational cloud seeding program relies upon a mix of suitable equipment, customized procedures and qualified personnel. Various components of this plan are discussed below.

4.1 Weather Radar

The Vandenberg AFB radar site has been utilized for the operation of the cloud seeding program since 2001. It provides information on precipitation location and intensity, as well as wind speed and direction within the precipitation echoes and a large array of additional products. The radar step-scans through 14 different elevation angles in a six-minute period. The maximum range for the detection of precipitation echoes is 143 miles from the radar. These radar systems are operated and maintained by the National Weather Service (NWS). The NWS radar sites have dual polarization capability in recent years, which provides the ability for the radar to differentiate between various hydrometeor (precipitation) types and identify non-weather phenomenon such as insects, dust, and ground clutter.

4.2 AHOGS Ground-Based Seeding Systems

The Automated High Output Ground Seeding Systems (AHOGS) allow automated, focused, high-output seeding releases from strategic ridgeline locations under program control from the project operations center with the proper computer software and password. These systems give the project meteorologist the ability to conduct intensive seeding of convection rain bands as they track into and across the project area under different wind flow regimes.

Each AHOGS site is controlled via a modem and can be connected via the internet where the LoggerNet software is installed. This software allows the user to manage the flare seeding operations and allows monitoring and reporting of AHOGS site status information, such as flare inventory and battery voltage. The project meteorologist has the option of igniting flares individually in real time, or to program the ignition of any number of flares at selected intervals and time blocks.

NAWC utilized the Arroyo Grande AHOGS flare site this season to seed the Lopez Lake target area. Location of the flare site is important since the effects of seeding will occur downwind (generally east through north of the site location). The Arroyo Grande site was selected specifically for targeting the Lopez Lake area under the most common lower-level wind flow regimes experienced with the passage of convective bands the area. Other AHOGS sites may be utilized in some situations depending on the wind patterns. Table 4-1 provides location and elevation information for the Arroyo Grande and two other AHOGS sites that have been occasionally used for the Lopez Lake target area.

Table 4-1
Primary AHOGS Site Locations

Location	Latitude (N)	Longitude (W)	Elevation (ft.)
Arroyo Grande	35.119	-120.567	300
Mt. Lospe	34.897	-120.595	1570
Berros Peak	35.062	-120.437	1610

These systems were designed for intensive seeding of convection bands using high-output pyrotechnic flares. Each AHOGS consists of the following primary onsite components:

- Two flare masts, which hold a total of 32 fast-acting seeding flares.
- Spark arrestors that enclose each flare.
- A control mast with an environmentally sealed control box containing a cellular phone communications system, digital firing sequence relays/controller, data logger and system battery.
- A solar system to maintain site power.
- Cellular phone antenna.
- A video camera to provide project meteorologists with on the ground storm visuals and to allow them to observe flare ignitions.

The pyrotechnic flares used at the AHOGS sites produce high-output, fast-acting silver iodide complexes during a burn time of approximately 3-4 minutes. Even though the cloud seeding program is conducted during the winter season, there can still be periods when the ground cover may be dry. Weed abatement and ground care is performed prior to the onset of each season, and periodically throughout the season as needed. Spark arrestors are placed over the flares to keep embers from reaching the ground. Figures 4.1 and 4.2 provide photos from one of the video cameras that show seeding flares burning in both day and night conditions. Figure 4.3 shows a close-up of the spark arrestors and Figure 4.4 shows a flare burning inside a spark arrestor.

Figure 4.1 **Flare burning at an AHOGS site during daytime conditions**

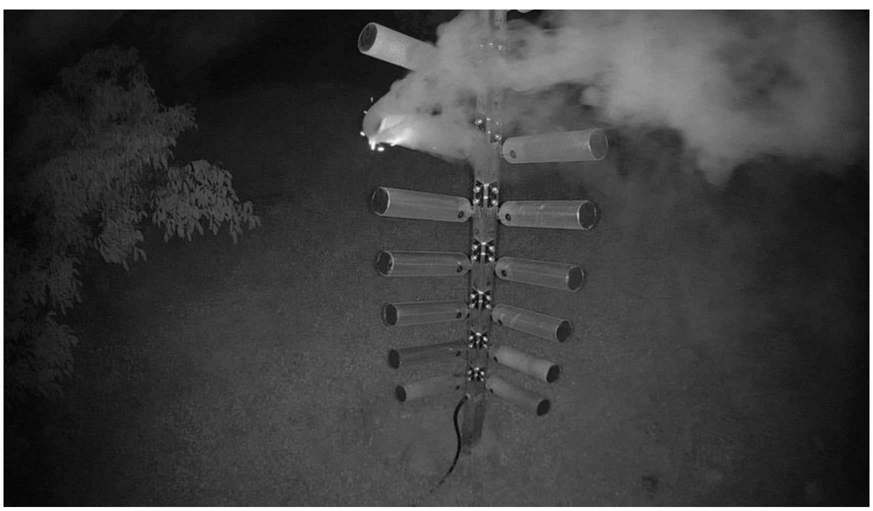

Figure 4.2 **Flare burning at an AHOGS site at night**

Figure 4.3 **Close-up of spark arrestors**

Figure 4.4 **Flare burning inside a spark arrestor**

The site video cameras are very useful during seeding operations since they allow the project meteorologist to immediately verify the firing of flares. If a malfunction were to occur, the project meteorologist could substitute another flare. Some site photos can be seen in Figures 4.5 – 4.6.

Figure 4.5 Photo of the Mt. Lospe AHOGS site

Figure 4.6 Photo of the Berros AHOGS site

4.3 Operations Center

NAWC's corporate headquarters in Sandy, Utah served as the operations center for the program. The project meteorologist's office and home computers have the LoggerNet software necessary to activate the AHOGS sites. A variety of meteorological data are used to assist in decision-making, as described in the following section.

4.4 Weather Forecasts and Meteorological Data Acquisition

NAWC project meteorologists were responsible for the determination of when seedable conditions were present and whether seeding suspension criteria were met. Coordination between NAWC's project meteorologist and Mr. David Spiegel, of the San Luis Obispo County Department of Public Works, was involved in the decision-making process. NAWC's project meteorologists were also responsible for archiving relevant weather data (for example, local NEXRAD radar displays, satellite photos and rainfall data) from each event. Examples are shown in Section 5.0, which discusses last season's operations.

A variety of weather information is available online that was used to forecast approaching storms, observe weather conditions during storms as they passed through San Luis Obispo County and document conditions of interest (to seeding decisions) or of concern, for example those related to suspension criteria. Some of these useful products include:

- Upper-air data, from both forecast models and observations such as rawinsondes. Typically wind speed, direction, and temperature and moisture data are available at important levels such as the surface, 850, 700, and 500 mb.
- Weather radar data which allow the meteorologists to view many important parameters before and during seeding operations, with scans at 5- to 6-minute intervals.
- Satellite imagery including visible, infrared, and water vapor presentations updated at intervals ranging from five minutes to one hour.
- Hourly observed precipitation data from ALERT rain gauge networks, as well as streamflow data.

4.5 Seeding Procedures

NAWC's conceptual model of the dynamics of the convection bands is that they are similar to convective bands that can occur in other parts of California during winter storms and other parts of the U.S. when a frontal structure is involved. The primary low to mid-level inflow to these bands is usually along the leading edge of the bands. These inflow regions are the areas containing stronger updrafts and are also the development and accumulation zones of supercooled liquid cloud droplets. Consequently, this is the desired region for the introduction of the seeding material. This would mean that flares burned at the ground sites would be timed to occur as the leading edge of the bands, as determined by the Vandenberg AFB NEXRAD radar, approached the ground sites. Low-level winds from the surface up to roughly the -5°C level are considered for targeting of seeding effects, as well as the avoidance of seeding over areas that meet any suspension criteria. The HYSPLIT model, discussed in Section 6.0, was also used in real time to help forecast seeding material dispersion from available sites.

4.6 Suspension Criteria

Appendix B contains the suspension criteria for the program. Seeding suspension criteria were monitored closely during the 2022-23 season and were reached in January due to a particularly heavy storm event on January 9. This storm event produced 24-hour rainfall totals that exceeded a 25-year return period in some areas. Flooding concerns continued during subsequent rainfall event for the remainder of the season, and while re-activating the program was discussed, the program sponsors ultimately kept suspensions in place.

4.7 Personnel

The following agencies and personnel were responsible for the conduct of the 2022-2023 cloud seeding program.

San Luis Obispo County
Department of Public Works
Mr. David Spiegel, P.E.

North American Weather Consultants
Mr. Garrett Cammans, President
Mr. David Yorty, primary Project Meteorologist
Mr. Todd Flanagan, back-up Program Meteorologist
Mr. Tom Segura, Local Equipment Technician

5. OPERATIONS

All operations were conducted in accordance with established suspension criteria, which were developed for a variety of situations, such as high intensity rainfall, flood warnings and streamflow discharge. Suspension criteria can be found in Appendix B.

The 2022-2023 winter season was again characterized by a La Niña phase of the El Niño Southern Oscillation (ENSO). While this phase frequently results in below average precipitation over central and southern California, rainfall this season was far above the average and was above average in essentially every month of the December – March season. Most sites recorded more than double (> 200%) of their average total water year (total annual) precipitation as of the end of April, and in fact reached these values by the end of March (with April being essentially dry).

Summary of the 2022-2023 Winter Season Rainfall

San Luis Obispo County rainfall for the 2022-2023 season was much above normal across nearly all of California and the Great Basin region, as shown in Figure 5.1. The Central Coast region was particularly hard hit with some very heavy and significant rainfall events, and this happened repeatedly during the season.

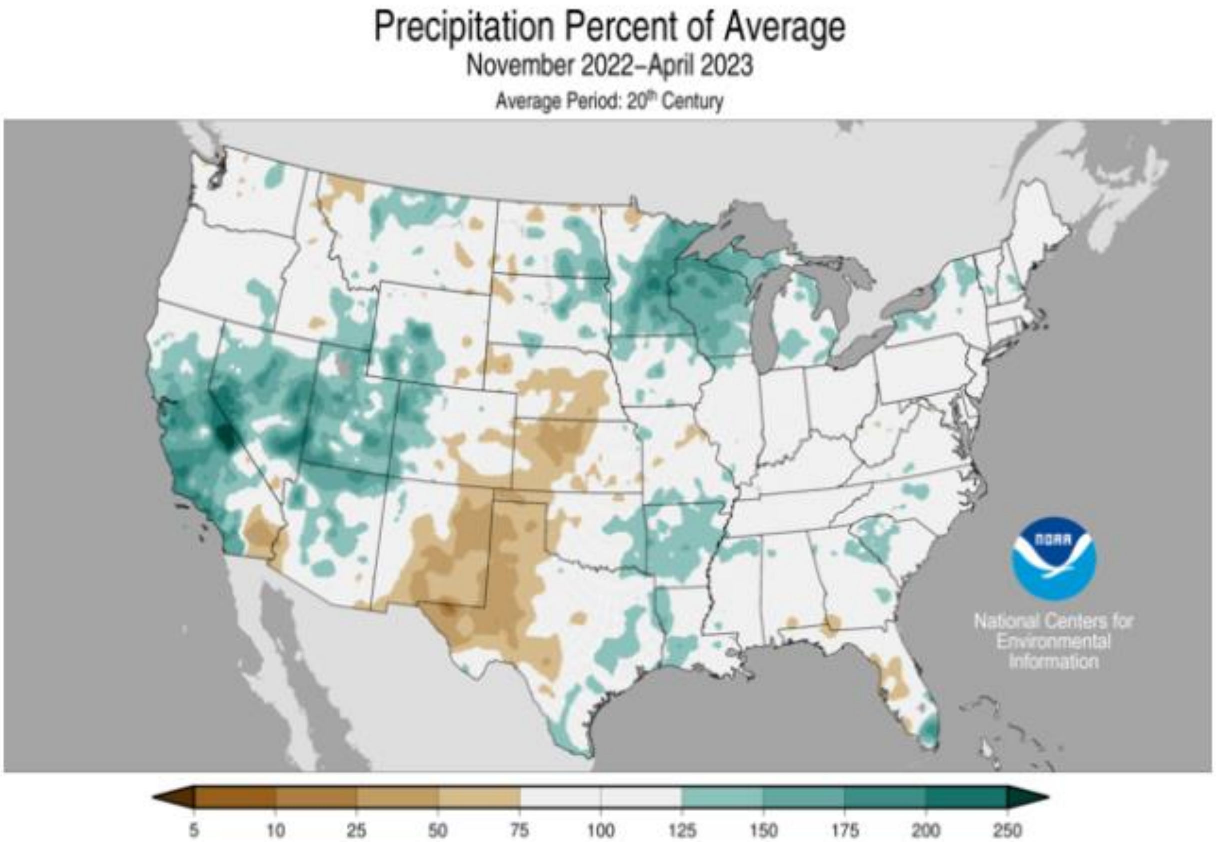

Figure 5.1 November 2022 – April 2023 percent of normal precipitation

December brought well above normal rainfall to all of the Central Coast region, with four seeded storm events in December and a total of 20 seeding flares used for the Lopez Lake target area. There were some other rainfall periods (December 1-2, December 6, December 27) that did not produce seedable conditions for ground-based sites due to various combinations of high wind speeds, high -5°C levels, stable layers below the -5°C level, and a lack of convective precipitation bands with some systems. There were no suspensions of seeding activity due to rainfall amounts or flood warnings in December.

January was an active weather month, mainly during the first half of the month with precipitation being well above average. The second half of January was much drier. A very heavy rainfall event on January 9 (perhaps on the order of a 25-50 year return period for a 24-hour event) led to a seeding suspension for the Lopez Lake target area. The one seeded event in January occurred on the 5th, with five ground-based and three aircraft seeding flares for the Lopez Lake area on that day.

The weather in February included a more significant dry spell mid-month, although it did bring a number of storm events as well. Precipitation totals for the month were again above average, due in large part to a major storm event during the February 23-25 period. Seeding operations remained suspended in February.

Precipitation in March was once again far above normal, with several major storm events during the month. There were no seeding operations in March, as excessive rainfall resulted in continued suspension of the program.

Figures 5.2 - 5.6 show a month by month glace at percent of normal monthly precipitation patterns this season for the United States.

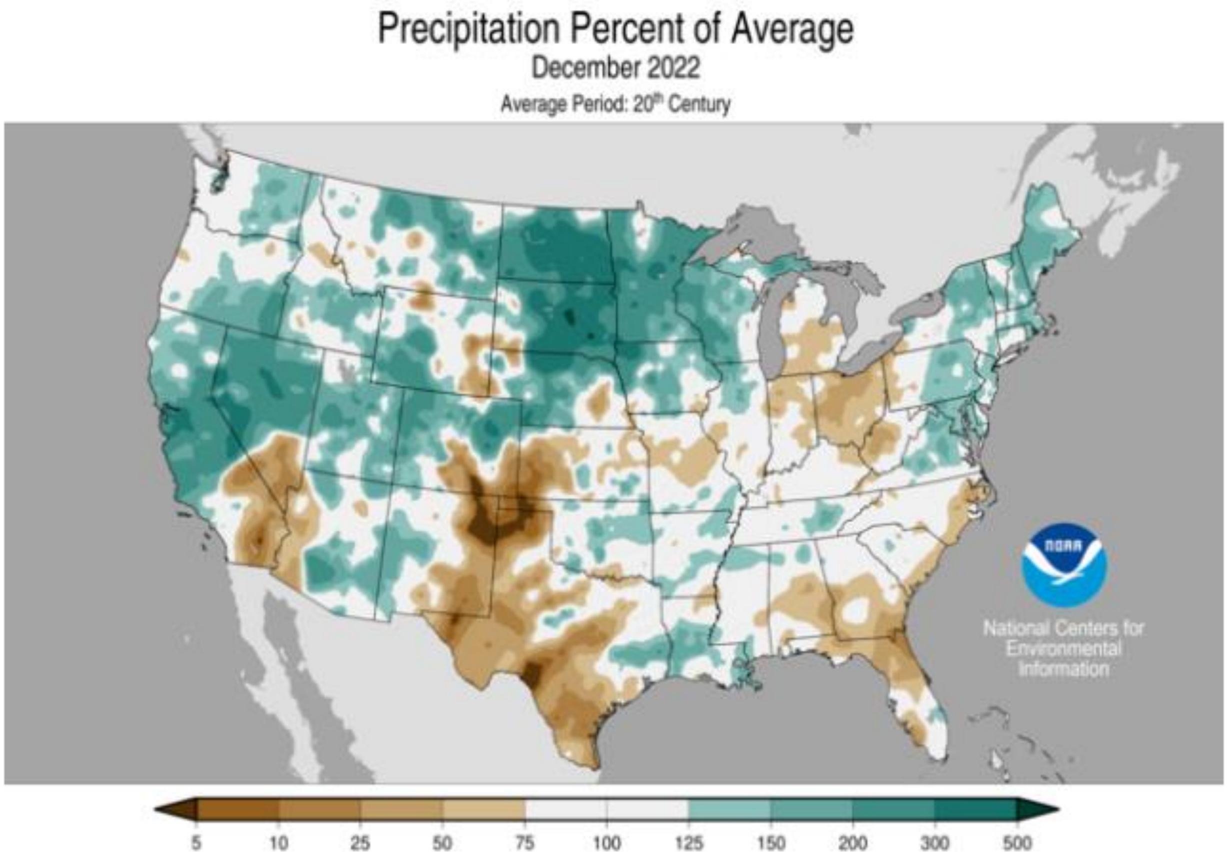

Figure 5.2 **December 2022 Percent of Normal Precipitation**

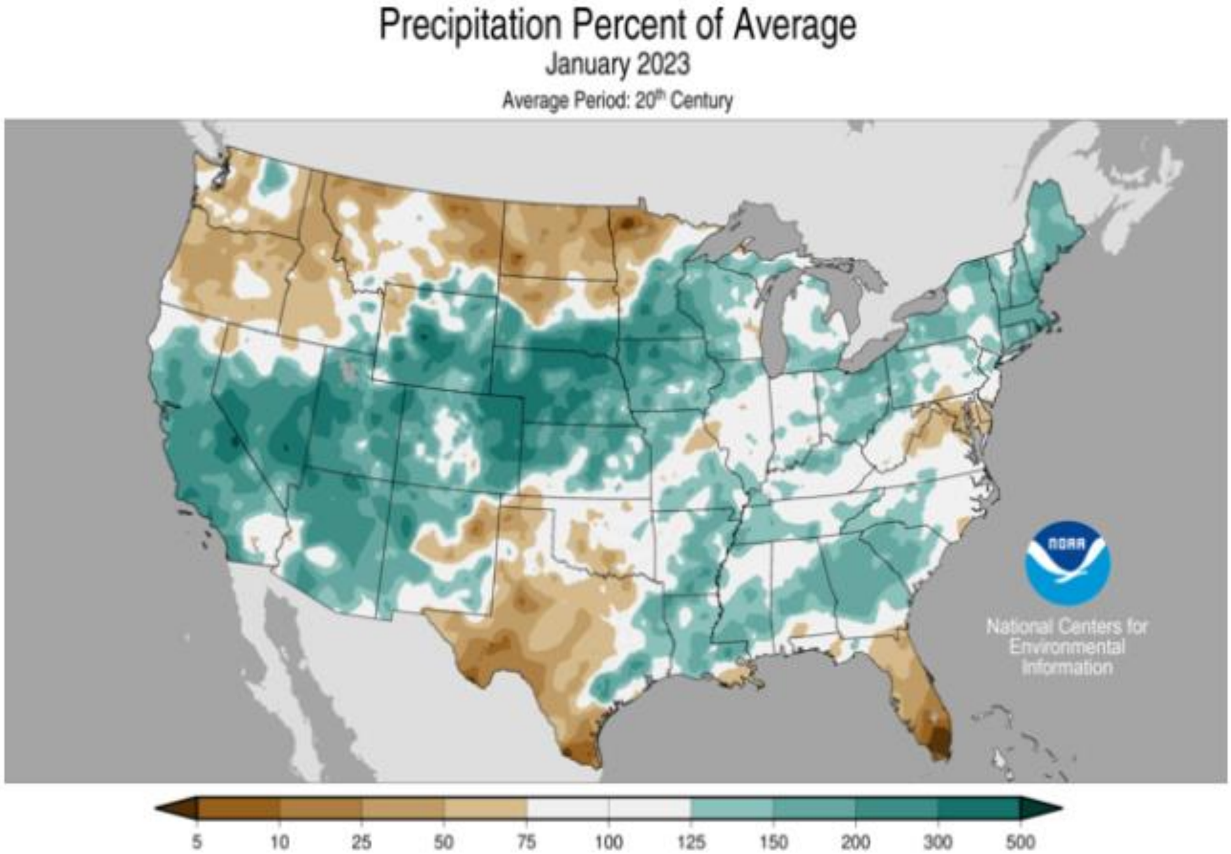

Figure 5.3 **January 2023 Percent of Normal Precipitation**

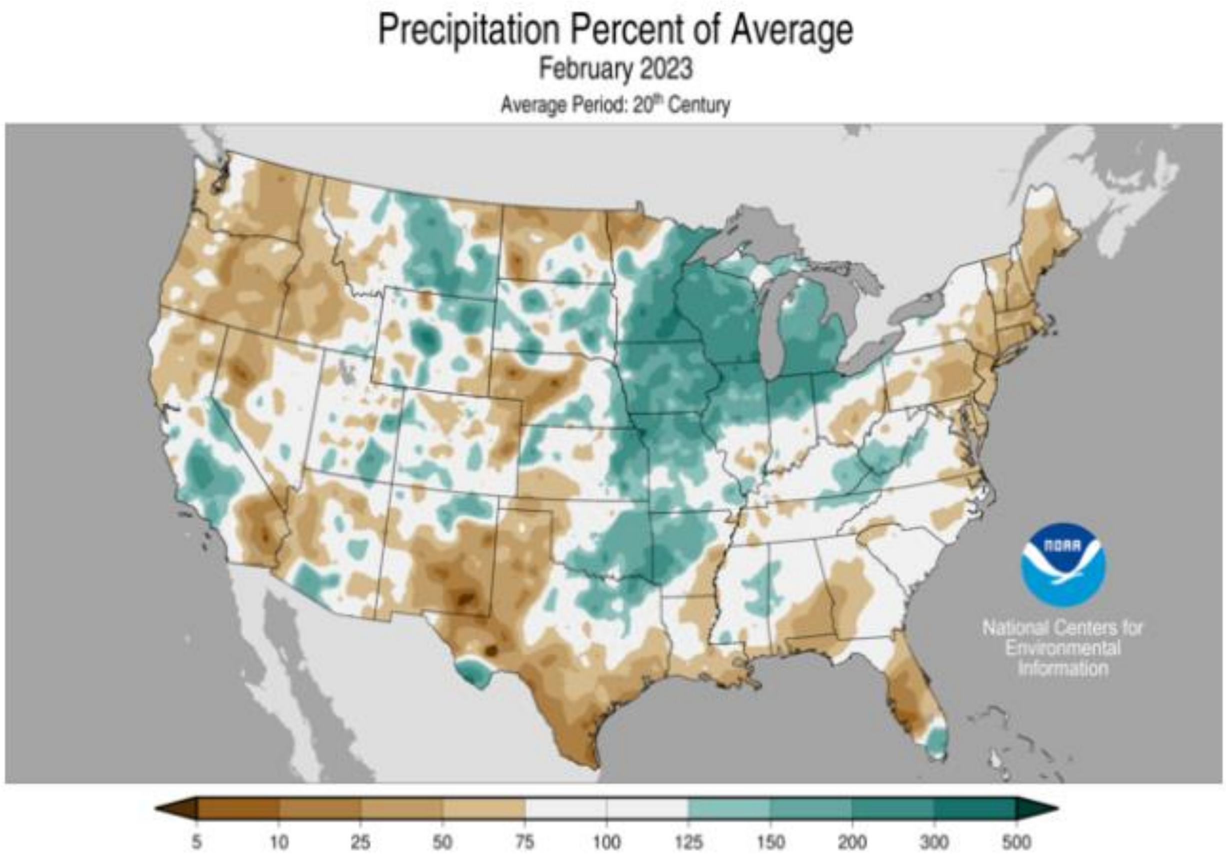

Figure 5.4 **February 2023 Percent of Normal Precipitation**

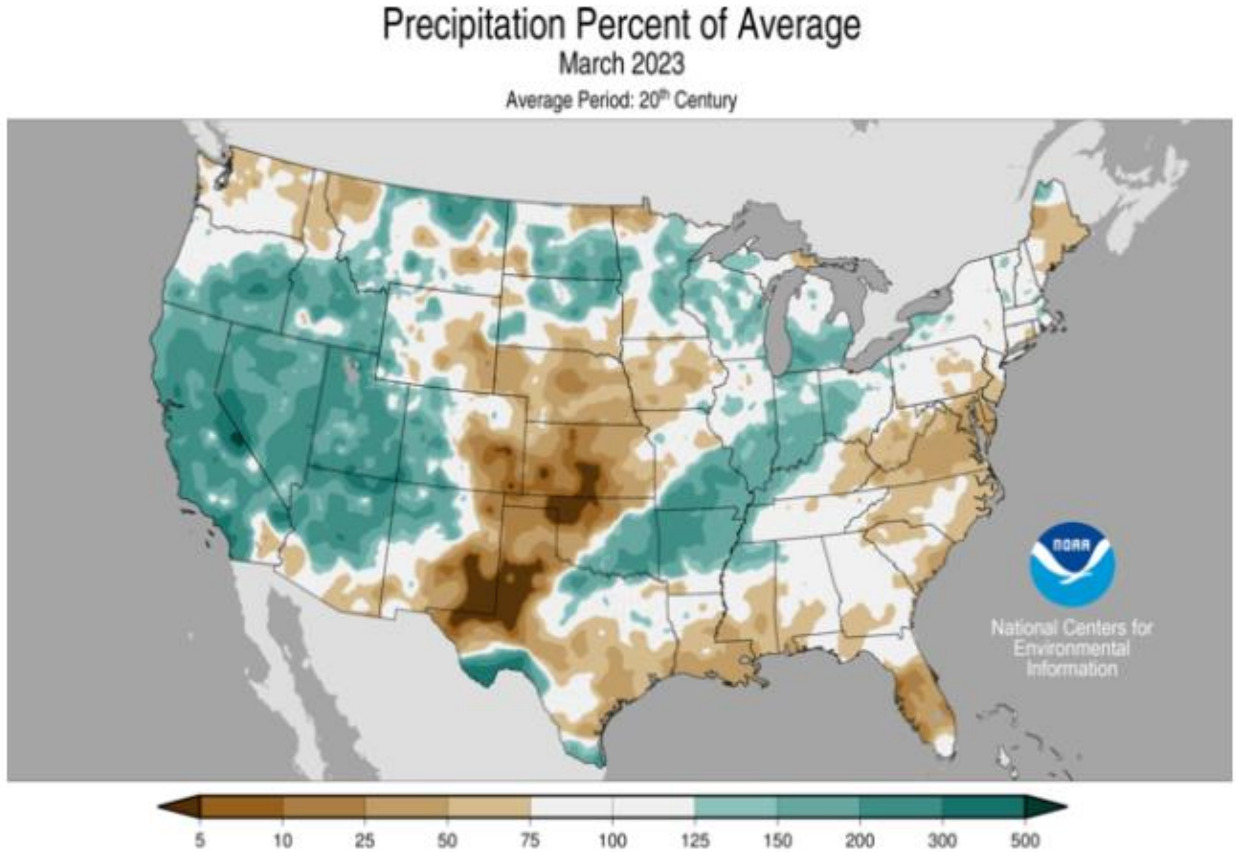

Figure 5.5 March 2023 Percent of Normal Precipitation

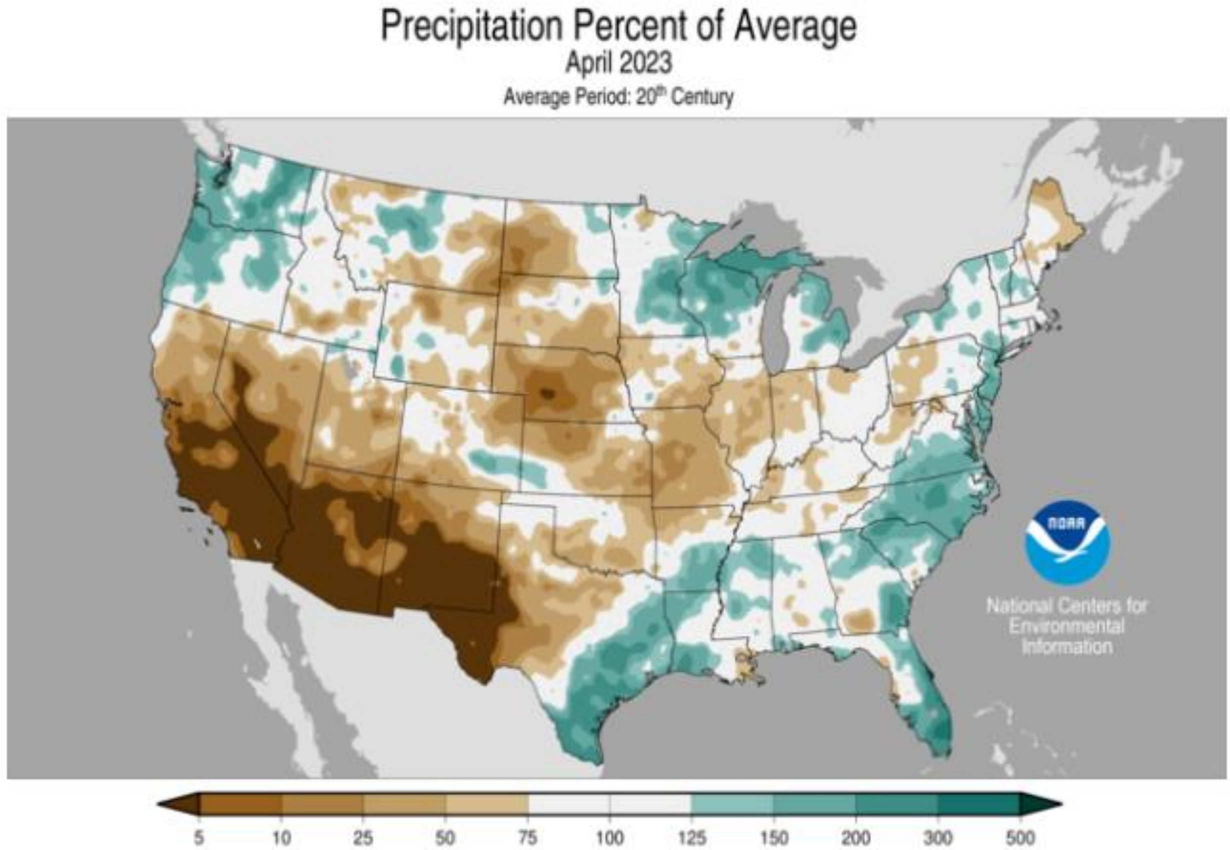

Figure 5.6 **April 2023 percent of normal precipitation**

5.1 Hydrologic Conditions During the 2022-2023 Winter Season

In Figure 5.7, it can be seen that streamflow in Lopez Creek (near Arroyo Grande) increased significantly in December, peaking during January and again in March during and following some heavy rainfall events. Daily average flows exceeded 200 ft^3/s during some time periods and approached 500 ft^3/s in March. Streamflow gradually decreased in April but remained high at this gauge site.

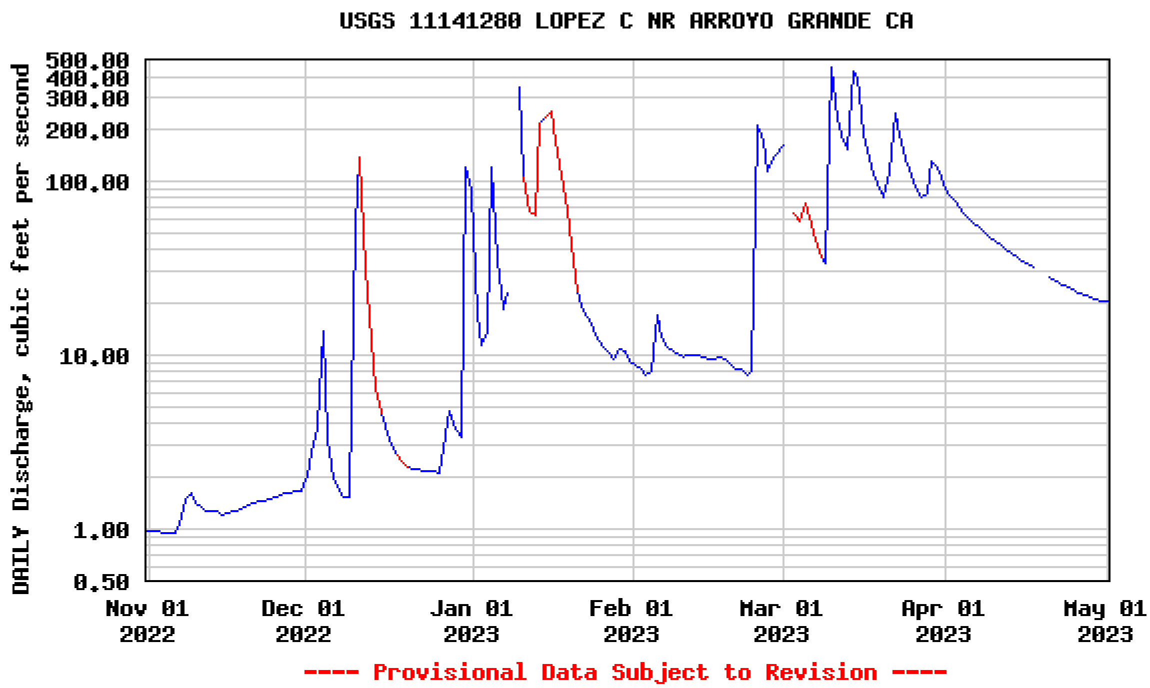

Figure 5.7 **Streamflow on Lopez Creek near Arroyo Grande from November 1 to May 1**

5.2 Summary of Operations during the 2022-2023 Winter Season

Table 5-3 summarizes flares used at the various seeding sites during the current season.

Table 5-3
Flare Usage

Date	Arroyo Grande	Aircraft
December 1-2	1	
December 6	1	
December 11-12	11	
December 31	7	
Jan 5	5	3
Total	**25**	**3**

5.3 Storm Events of the 2022-2023 Winter Season

This section describes the storm events that affected the Lake Lopez watershed area during the 2022-2023 operational period. A general discussion of the meteorology accompanying each event is given, followed by a description of the seeding operations (if any). Wind directions, when provided, are always reported in the direction from which the wind is blowing (e.g., a southerly wind means the wind is blowing from the south toward the north). Wind speeds are usually reported in nautical miles per hour (knots), with 1 knot equal to 1.15 miles per hour. Figures shown in the storm summaries may include the following:

- Satellite images, including infrared (IR), water vapor (WV), or visible. Infrared images provide information during both the day and night which primarily consists of the cloud top temperatures. Water vapor can be useful when determining where upper level dry or moist air exists, and visible satellite images can be helpful for observing cloud structure.
- National Weather Service NEXRAD radar images, showing reflectivity values associated with precipitation near the times when seeding occurred. These images give an indication of the type, intensity, and extent of precipitation during seeding periods. Wind direction and velocity are also observed by the radar through the Doppler feature, which is part of the NEXRAD design. Plots of winds with height in 1000-foot increments are available with a six-minute time resolution from NEXRAD radars. These displays are called Velocity Azimuth Displays (VAD).
- Skew-T upper-air soundings from Vandenberg AFB. The skew-T sounding is a plot of temperature, dew point, and winds vs. height, observed by a radiosonde (balloon borne weather instrument). This sounding information is useful for analyzing various parameters of the atmosphere, providing temperature and moisture profiles and convection potential. Soundings are available twice daily at 0400 and 1600 PST. The 700-mb (approximately 10,000 feet) temperatures are frequently reported in the following storm summaries. NAWC typically prefers to see these temperatures at -5°C or colder during seeded periods since silver iodide becomes effective as a seeding agent between -4°C and -5°C. The closer the height of the -5°C level is to the ground seeding sites, the quicker a seeding effect will begin to be produced in the convection elements embedded in the convective bands. These convective elements transport the seeding material vertically from the ground seeding sites to colder temperatures aloft.

<u>December 1-2, 2022</u>

A system developing on December 1 was actually a complex merging of two separate systems in the eastern Pacific and resulted in a fairly broad band of moisture that concentrated precipitation along a frontal boundary later in the day. Figure 5.8 is an infrared satellite image during the early evening hours.

By 1700 PST the frontal boundary began moving into portions of SLO County. Winds at low levels remained southeasterly ahead of the front and southwesterly above about 4,000 feet, with a net wind direction of south-southwesterly between the surface and -5°C level. Winds were roughly 40 knots through this entire layer. A HYSPLIT model plot of potential seeding site plumes showed them moving almost due north at least early in the event, around 1800 PST.

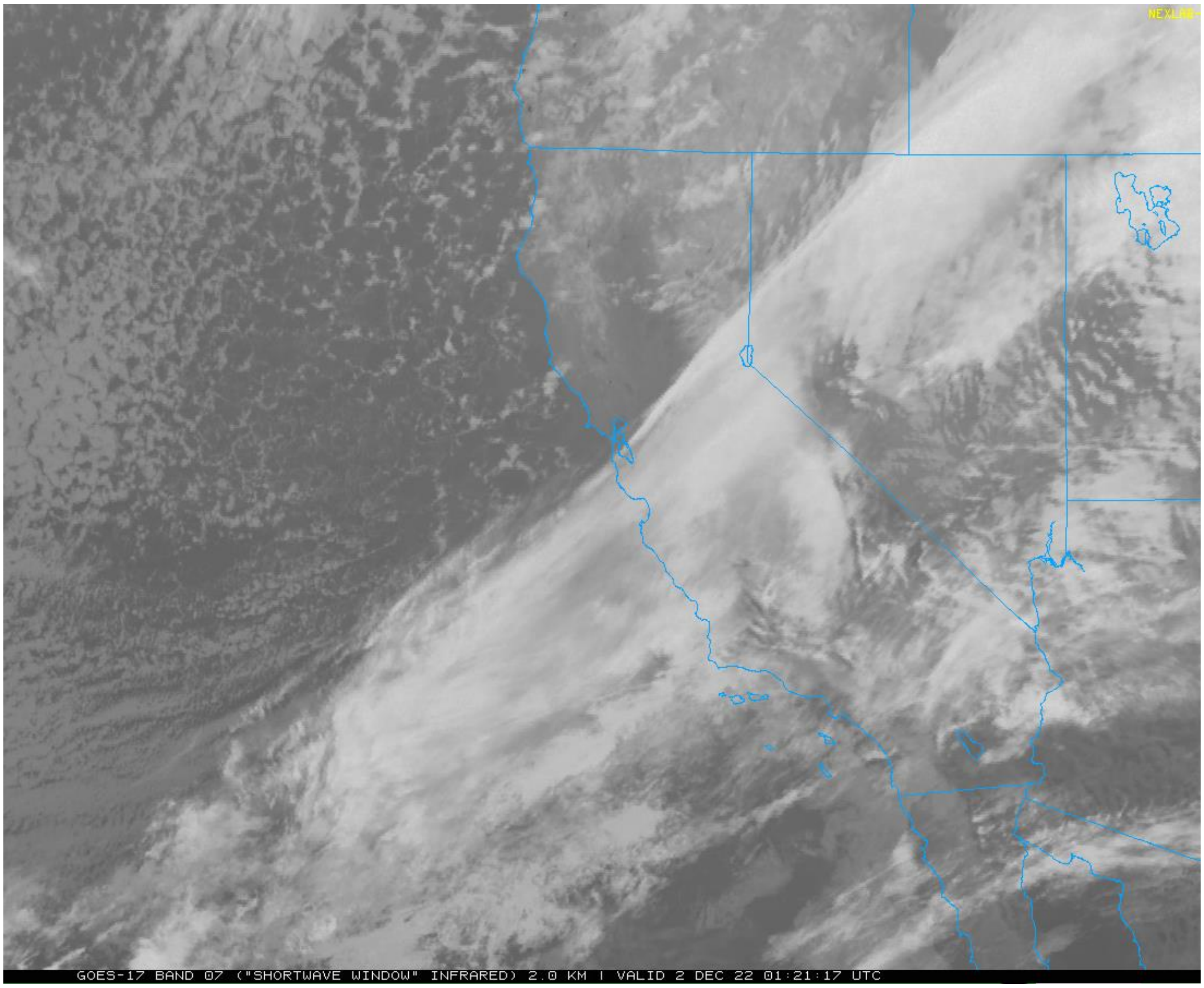

Figure 5.8 Infrared satellite image at 1721 PST December 1

As the frontal band slowly approached the Arroyo Grande site in SLO County, localized segments of the band having high radar reflectivities to 40-50 dBZ or more were indicative of some convection and stronger lift. Outside of this, the rain band appeared to be essentially stratiform with no real ground seeding potential. Hourly rainfall rates in SLO County ranged up to 0.3 – 0.4+" in some areas. A flare was burned at the Arroyo Grande site at 1854 PST with a narrow segment of the frontal band located a few miles north of the site. Figure 5.9 is a radar image somewhat prior to this. As of 1930 PST, the band segment in SLO county had slowly weakened and another segment offshore was approaching the coast near the SLO/SB County border. Winds remained southeasterly at the surface near sea level in all areas until the frontal passage.

After 2100 PST, precipitation weakened to mostly light and disorganized across the region and there was no further seeding opportunity. Precipitation totals were generally between a half inch and an inch during this storm.

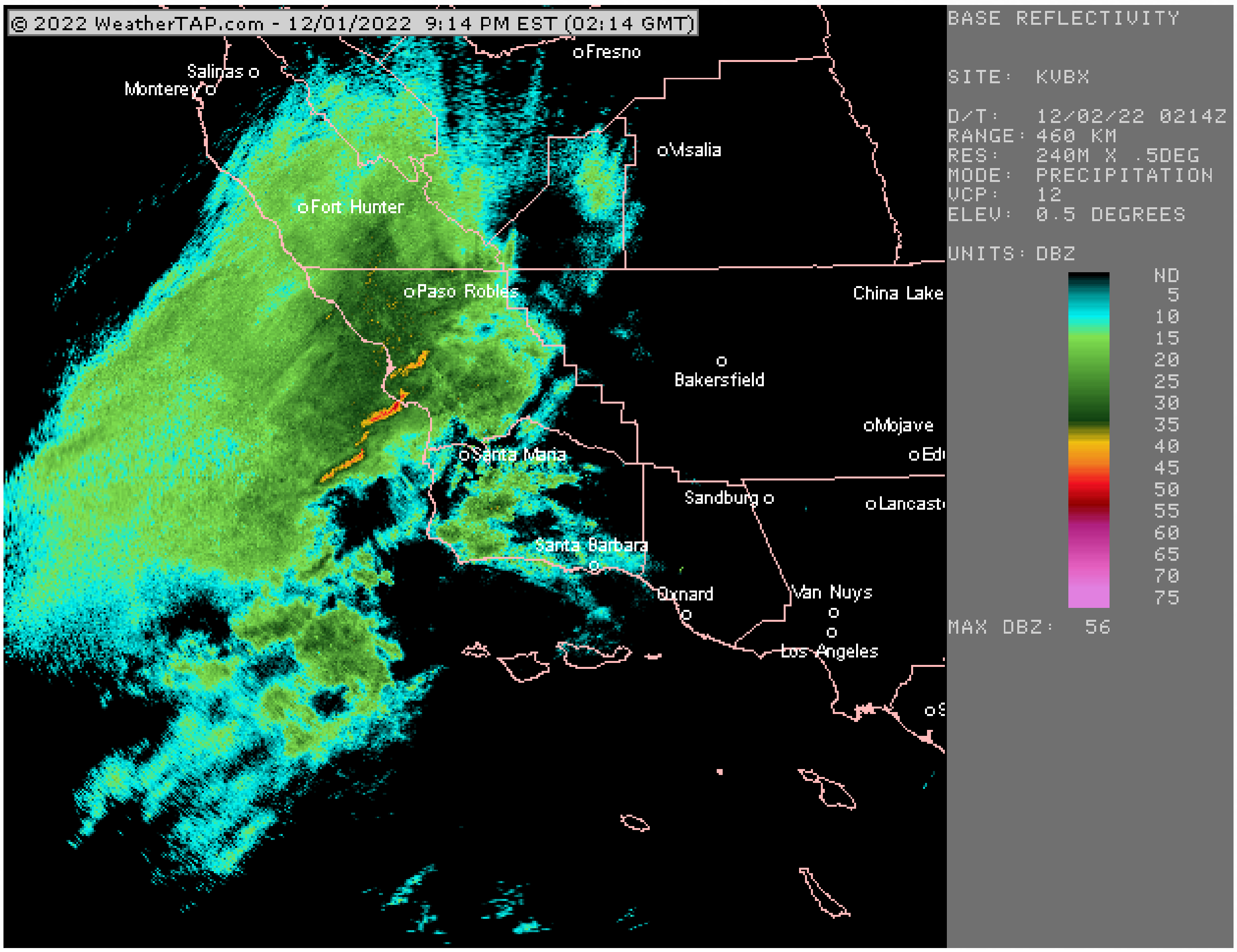

Figure 5.9   VBG radar at 1814 PST December 1

December 1 flare use summary

Arroyo Grande: 1854 PST

December 6, 2022

A weakening low center which had been located near the northern California coast for the past few days moved southeastward across the Central Coast region and SLO/SB counties by late on December 6. By 1600 PST, a weak convective band was moving onshore in portions of SLO County. Hourly rainfall up to 0.10” or greater were observed in some areas a bit north of the Lopez Lake watershed. By 1700 the band had moved onshore and was mostly in SLO County, with a narrow portion also near the coast of SB County.

One flare was used at the Arroyo Grande site for Lopez Lake target area at 1705 PST. Figure 5.10 is a zoomed in radar image of this weak band near that time. The seeding conditions were rated as somewhat marginal due to the small size and weakness of this band and low expected precipitation amounts. A relatively low -5°C level near 9,000 feet and good vertical mixing of the air mass were positive factors, however. By 1730 the band had largely dissipated, and no further seeding was conducted. Rainfall totals were locally near a quarter inch just northwest of the Lopez Lake target in the San Luis Obispo area, but likely around 0.10” or less in the watershed itself based on available gauges.

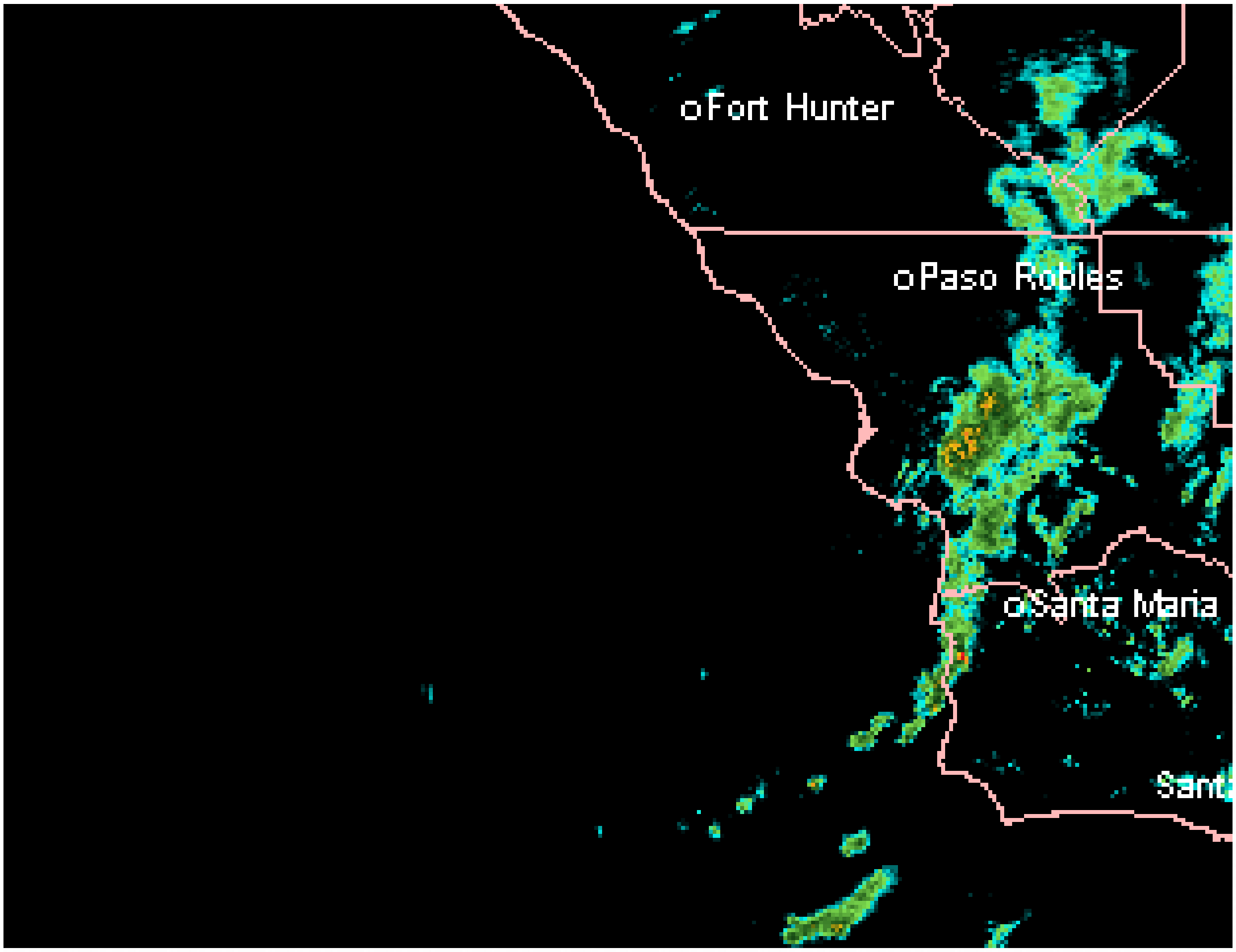

Figure 5.10 VBG radar image (zoomed) at 1702 PST December 6

December 6 flare use summary

Arroyo Grande 1705

<u>December 10-12, 2022</u>

A large and cold trough was located along and offshore of the west coast on December 10 (Figure 5.11). A moderate to heavy band of precipitation crossed the area on the night of December 10-11, from roughly 2000 – 0100 PST. This initial band was followed by additional convective showers in a colder air mass, with the snow level falling below 5,000 feet the first night and to near 3,500 feet the following night (December 11-12). While there were some breaks in storm activity during the day on December 11, the core area of the trough remained offshore and rotated southward to near the Central Coast region on the night of December 11-12, producing numerous additional convective bands (mostly small in scale).

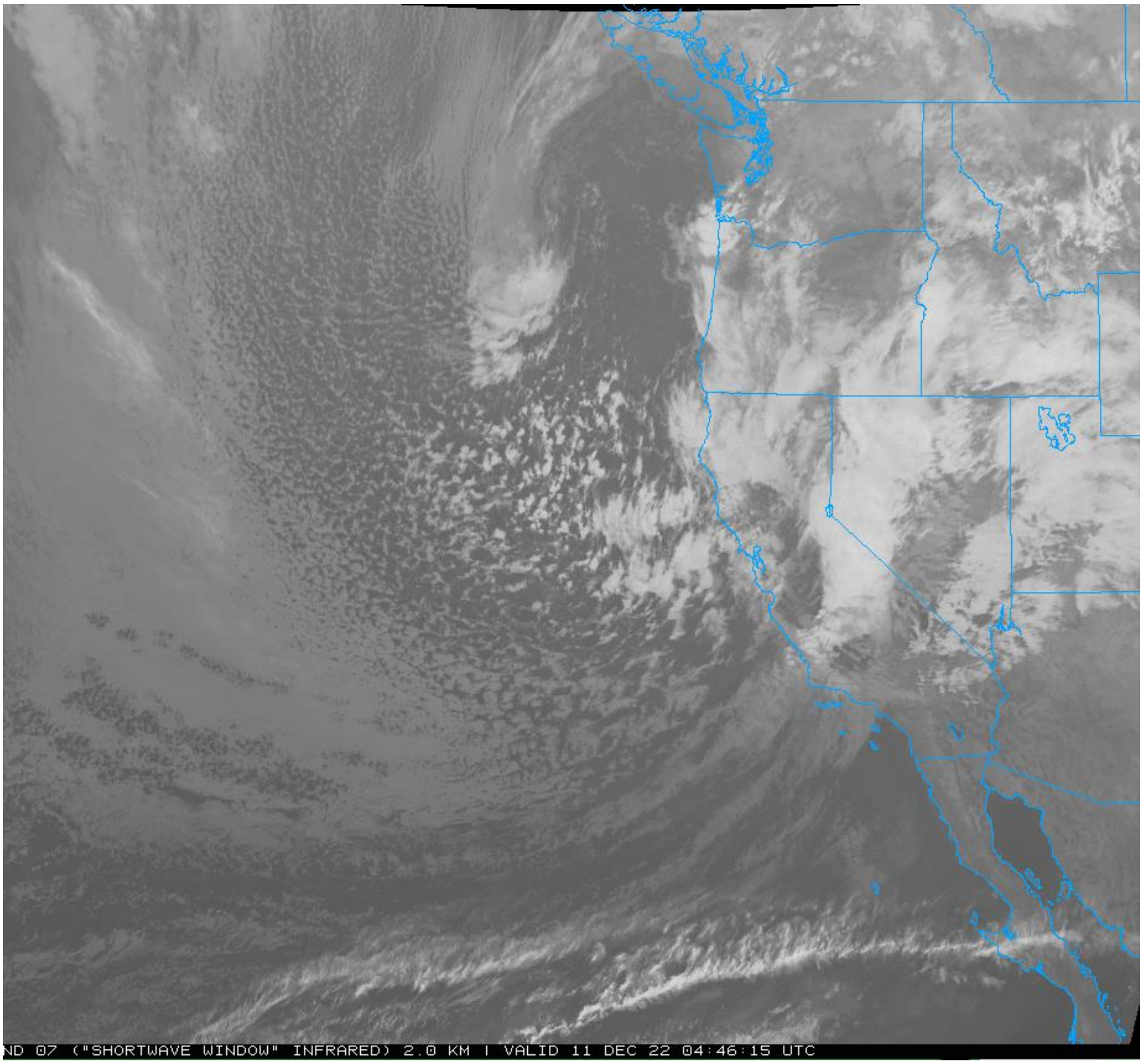

Figure 5.11 Infrared satellite image on the evening of December 10

The initial frontal band on the night of December 10-11 (Figure 5.12) produced rainfall rates exceeding 0.5"/hr at some spots in favored east -west oriented barriers. The National Weather Service (NWS) issued a flood advisory for portions of SLO/SB counties at 2027 PST December 10 for urban and small stream flooding. However, there were no flood warnings that would have resulted in any seeding suspensions. Winds were strong, from the south-southwest exceeding 50 knots from about the 3,000 foot level up to over 10,000 feet in elevation. There were some 60 knot winds (e.g. close to 70 mph) at some levels in the radar VAD profile, even as low as 5,000 to 6,000 feet.

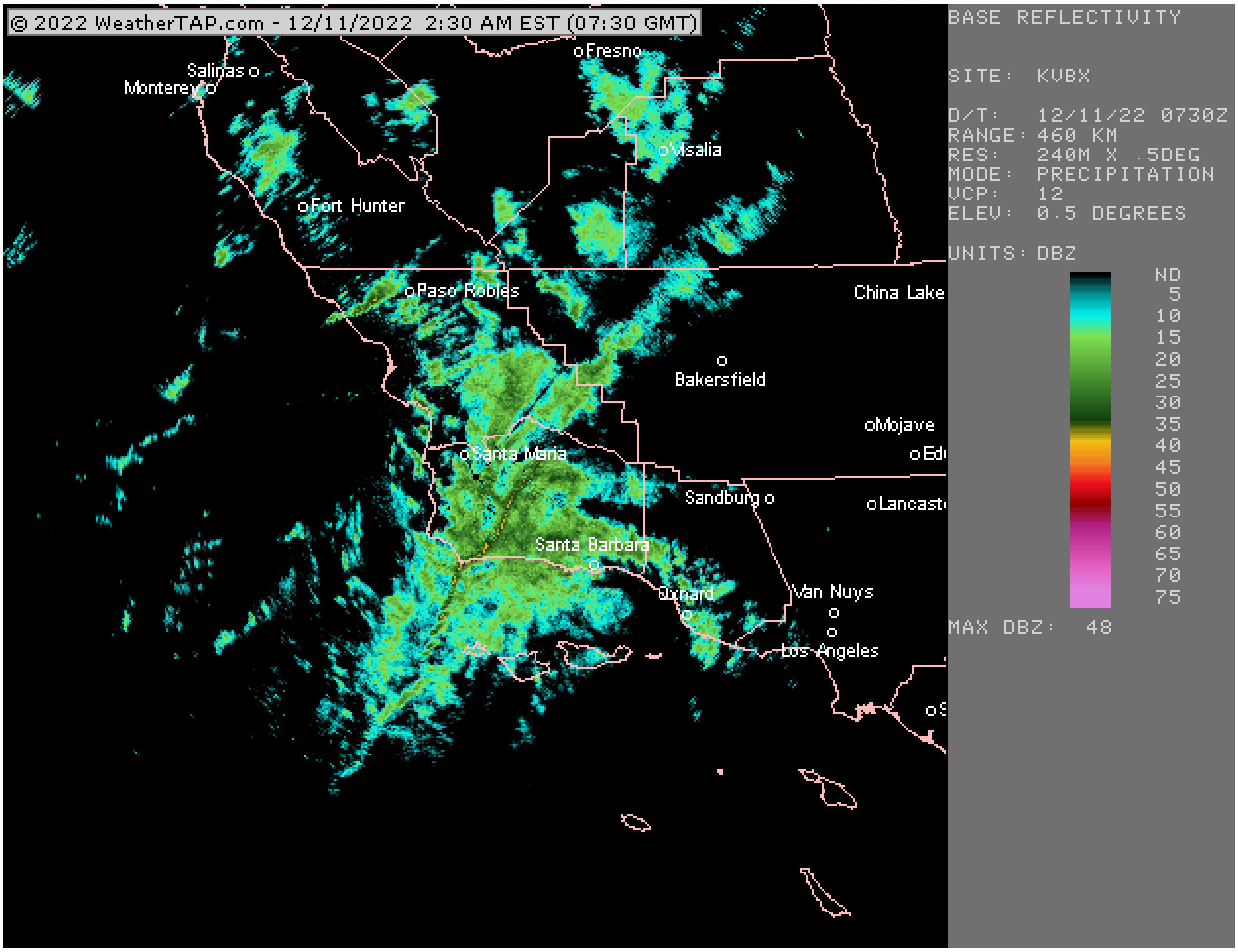

Figure 5.12 VBG radar image at 2330 PST December 10

After about 0100 PST December 4, precipitation became lighter and more showery. Winds were still quite strong, near 40 knots up to about 8,000 feet and around 60 knots near and just below the -5°C level near 700 mb (10,000 feet). By about 0400 PST, the core area of trough was bringing significant cooling to the area with 700 mb temperature near to below -7°C at that point. Numerous showers continued in southwesterly flow with westerly component gradually increasing. Winds remained too strong for use of the Arroyo Grande site during this period, given its proximity to the target area and the necessary time frame for the seeding process to take place.

During the day on December 11, showers became more isolated in a dry slot region of the storm with 700 mb temps cooling to the -8 to -10°C range. The main low center was located just offshore of far northern California in the morning and later moved south-southeastward just off the coast. A few flares were used in some late morning and afternoon showers on the 11th. Winds were nearly due westerly to slightly north of westerly during this time.

As the core of the trough moved southward on the night of December 11-12 (see satellite image in Figure 5.13), more significant convective bands started to move onshore again, and the winds shifted back to slightly south of due westerly. There were a total of about six to eight (mostly small) convective bands between about 2100 and 0600 PST that affected the area in association with the core of this trough overnight, and both target areas were seeded as appropriate. Radar images in Figures 5.14 – 5.16 show some of these bands of showers. This activity finally subsided in the early morning hours and operations ended around 0600 local time.

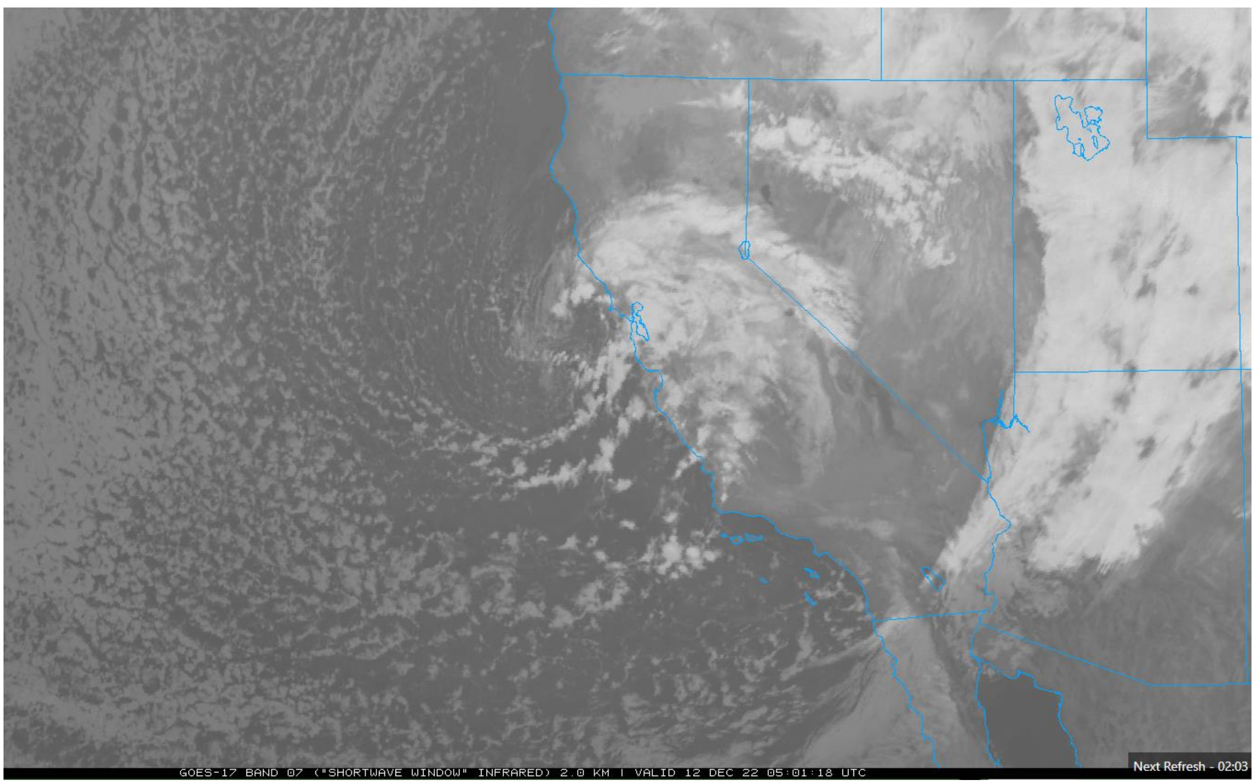

Figure 5.13 Infrared satellite image at 2101 PST Dec 11

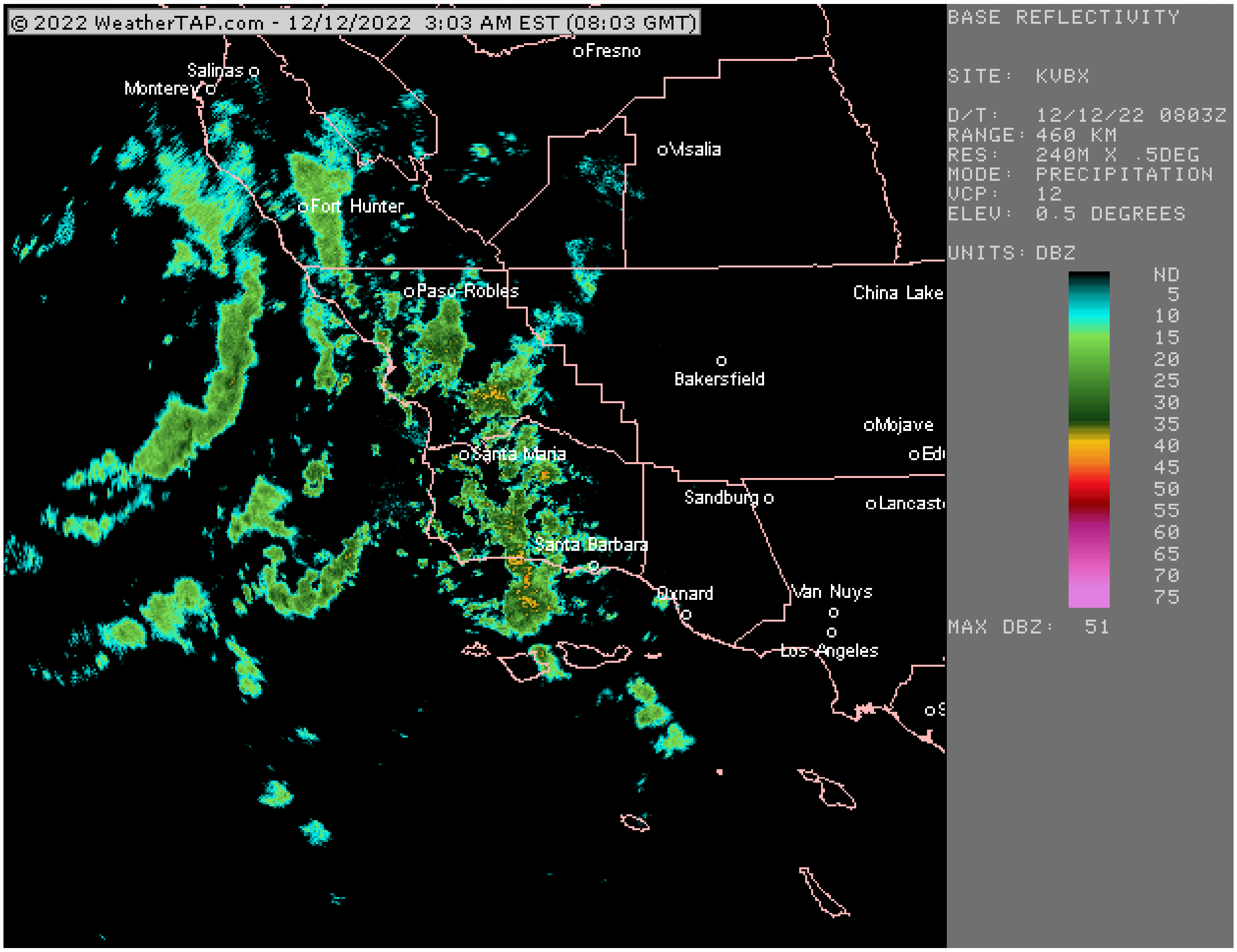

Figure 5.14 VBG radar at 0003 PST December 12

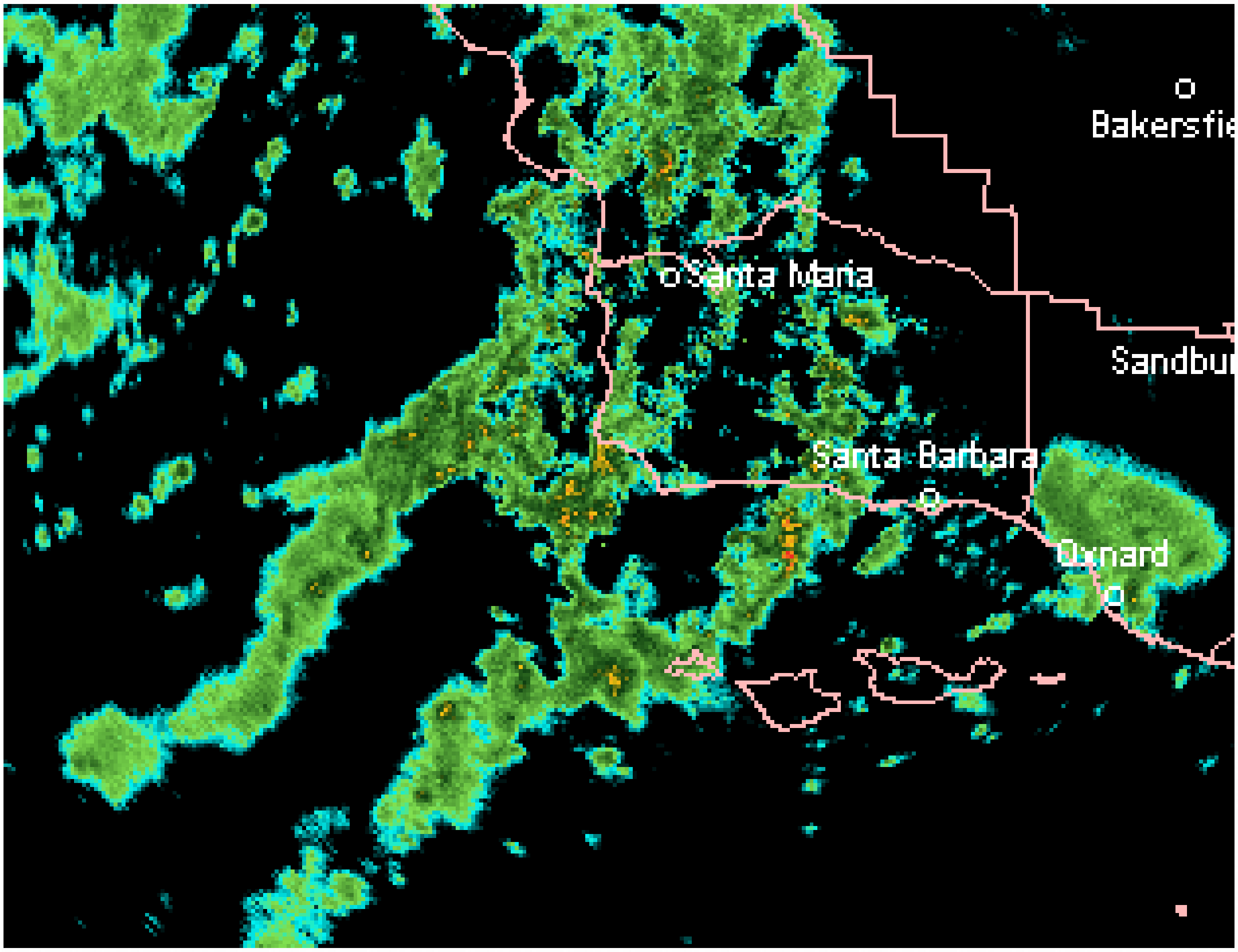

Figure 5.15 Zoomed in radar image at 0153 PST December 12

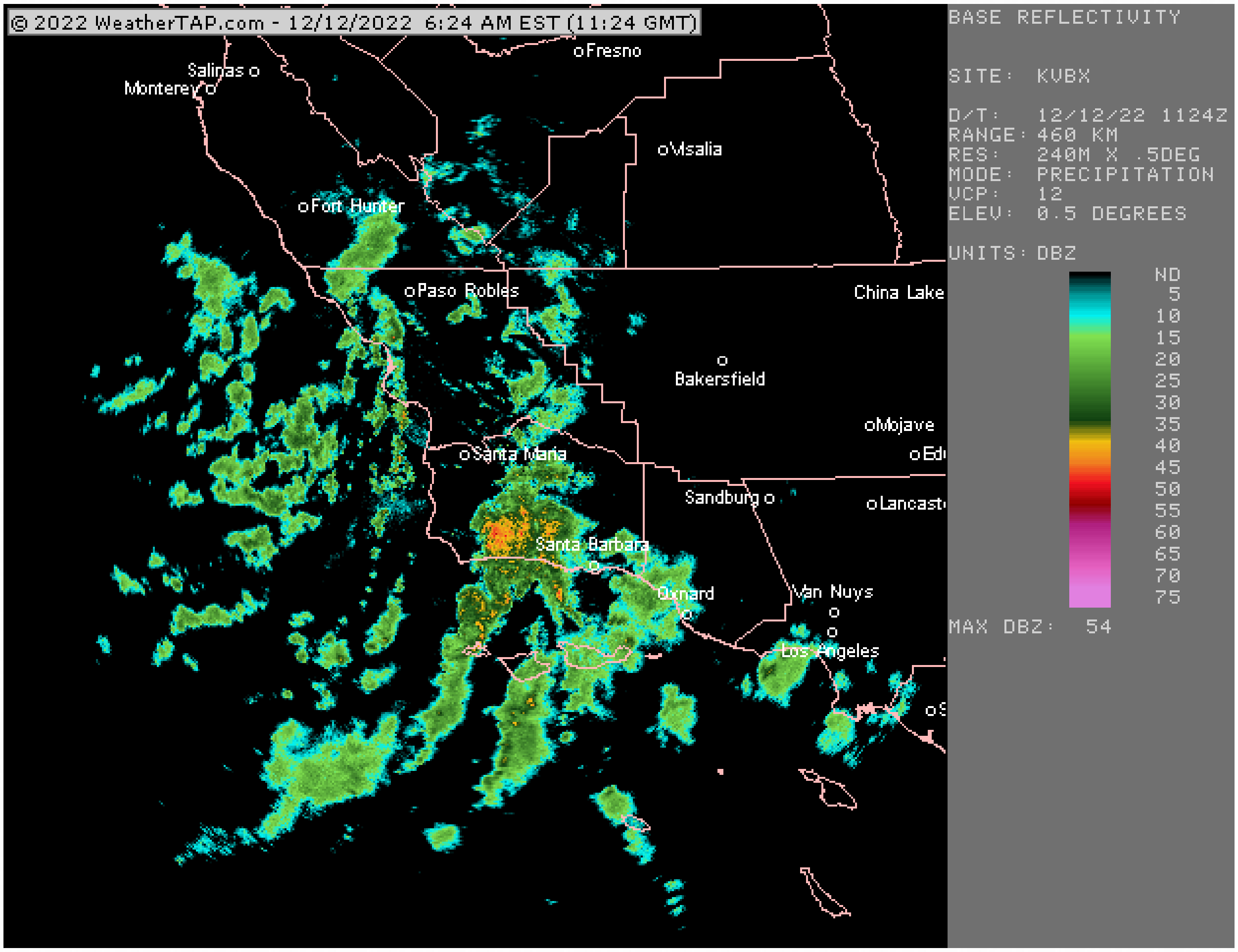

Figure 5.16 VBG radar image at 0324 PST December 12

Figure 5.17 shows the storm precipitation totals in SLO County, with likely totals of between about 2.0 – 3.5" in the Lopez Lake target area.

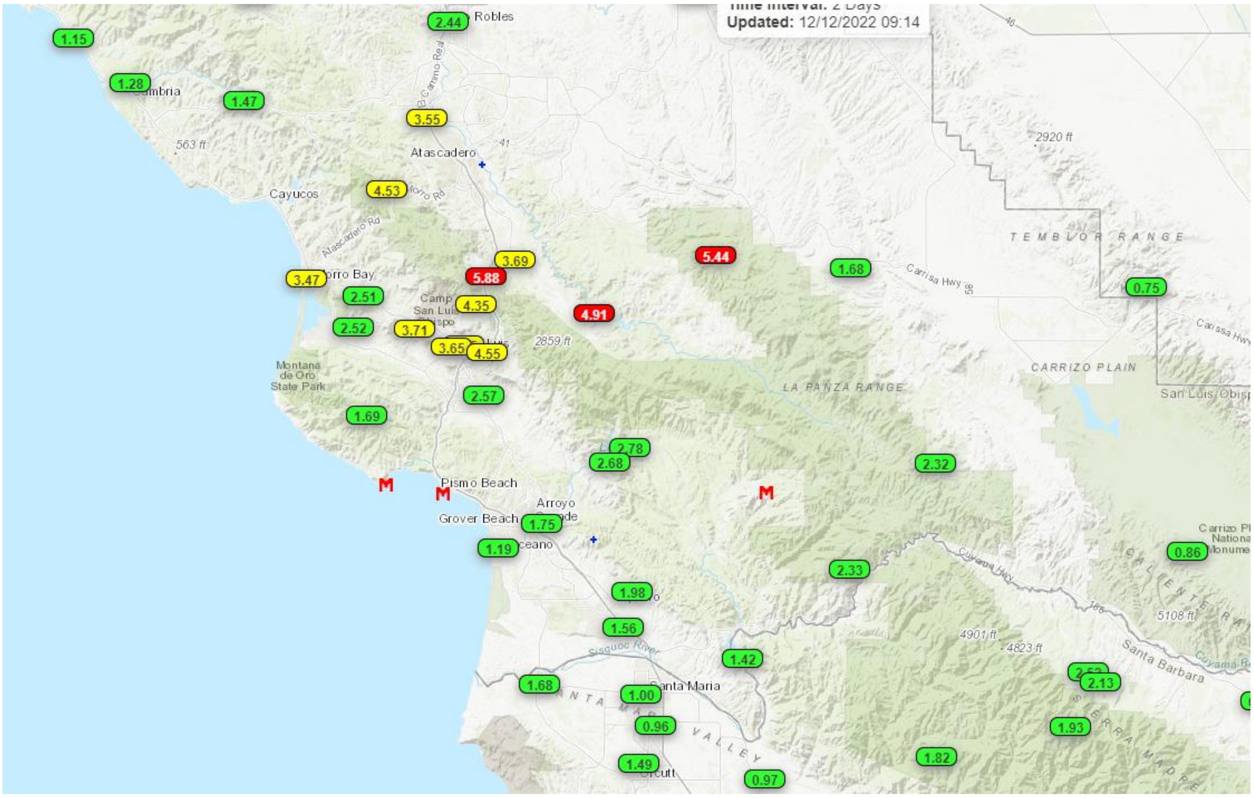

Figure 5.17 December 11-12 storm totals in SLO County area

December 11-12 flare use summary

Arroyo Grande: Dec 11 0416, 0422, 0515, 2012; Dec 12 0016, 0100, 0117, 0153, 0201, 0333, 0518

<u>December 31, 2022</u>

A deep trough was located off the coast on December 22 with a broad moisture plume and a band of moderate to heavy rainfall during the afternoon/evening hours. Figure 5.18 is a visible spectrum satellite image as this system began to move onshore during the afternoon. 700 mb temperatures were near 0°C on the leading edge of the band falling to around -5°C on the back edge and winds at this level were southwesterly near 40 knots within the precipitation band. By late afternoon a broad stratiform rain band was moving into the area. Radar echoes were quite uniform (around 35 dBZ intensity) within this band. The radar-derived wind profile showed southwesterly winds both at the surface and aloft. Forecast soundings showed a somewhat stable profile initially, becoming better mixed during the evening hours. HYSPLIT plots showed effective plume movement from the SSE initially, with winds becoming much more westerly after about 1800 PST.

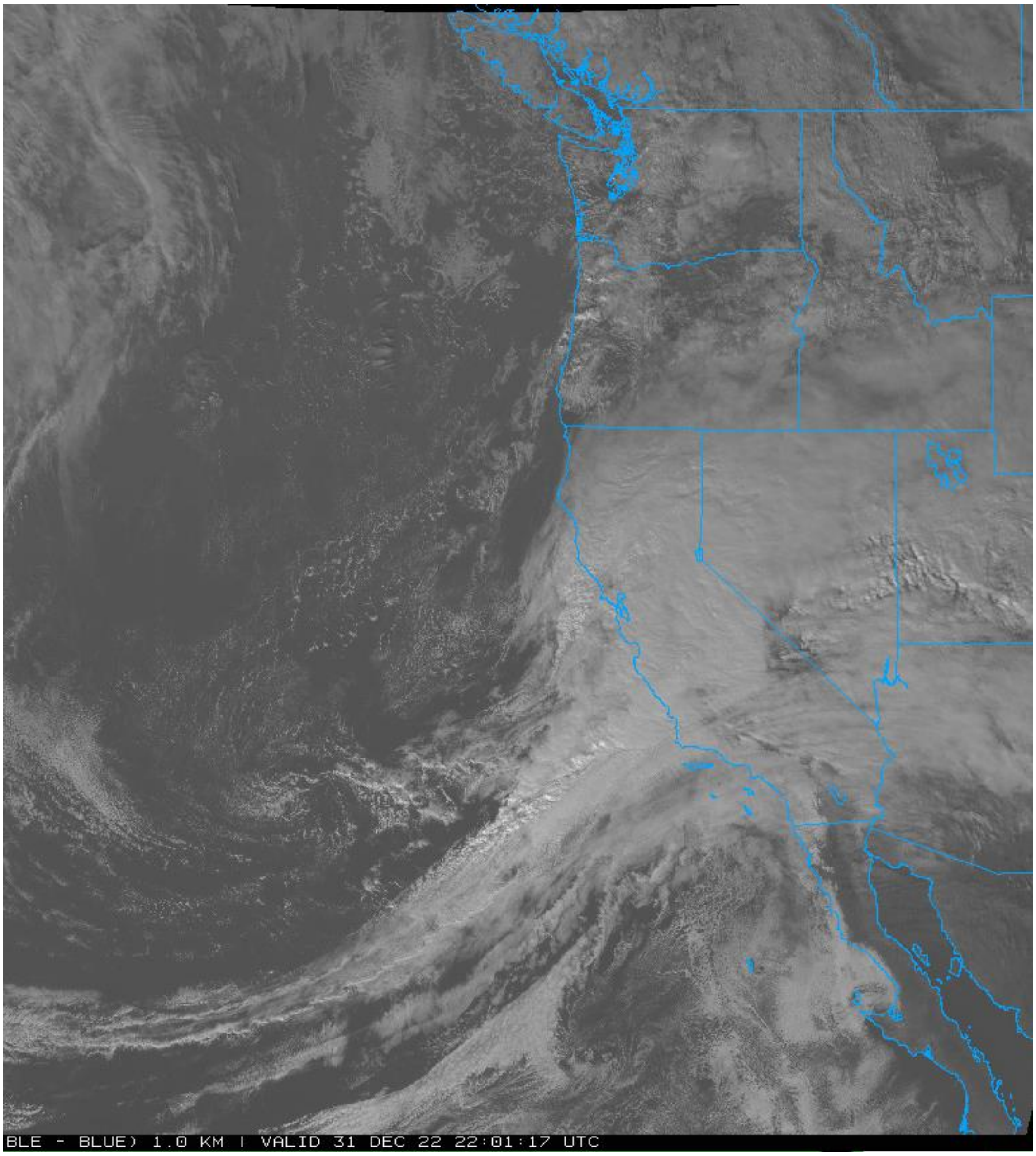

Figure 5.18 Visible spectrum satellite image at 1401 PST December 31

As temperatures cooled somewhat, seeding was conducted for the Lopez Lake target between 1800 and 1900 PST. This was in the absence of any real distinct convective bands initially, although a trailing band did develop along the back edge of the main precipitation band and was likely the most favorable seeding target during this event. Winds became more westerly, with a shift from southerly to northwesterly at the surface in association with this trailing band. Figure 5.19 shows this convective band moving into the area (across SLO County and near coast of SB County), in contrast to the stratiform type of precipitation in the main band further east. Figure 5.20 is a radar wind profile near this time as winds became more westerly.

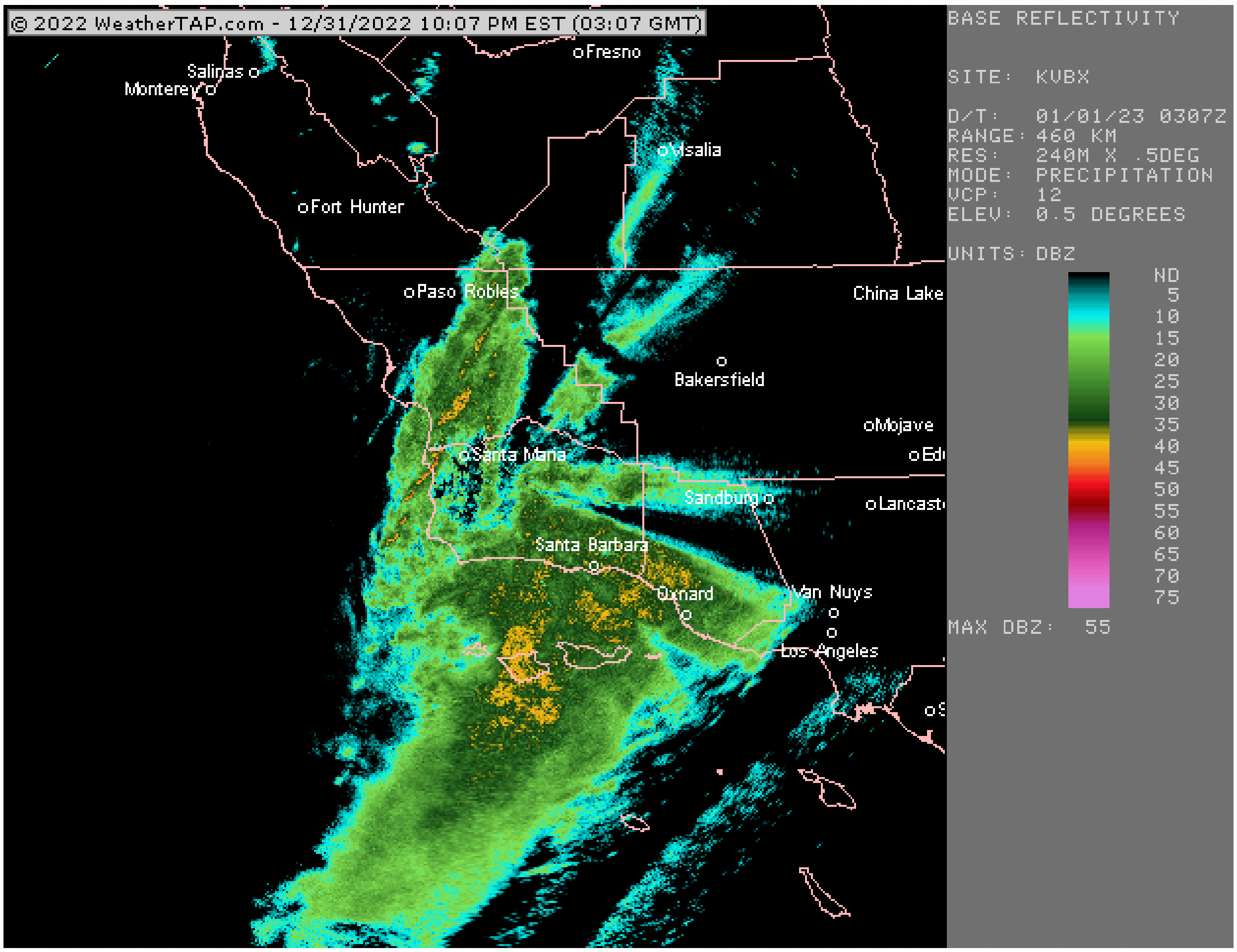

Figure 5.19 VBG radar at 1907 PST December 31

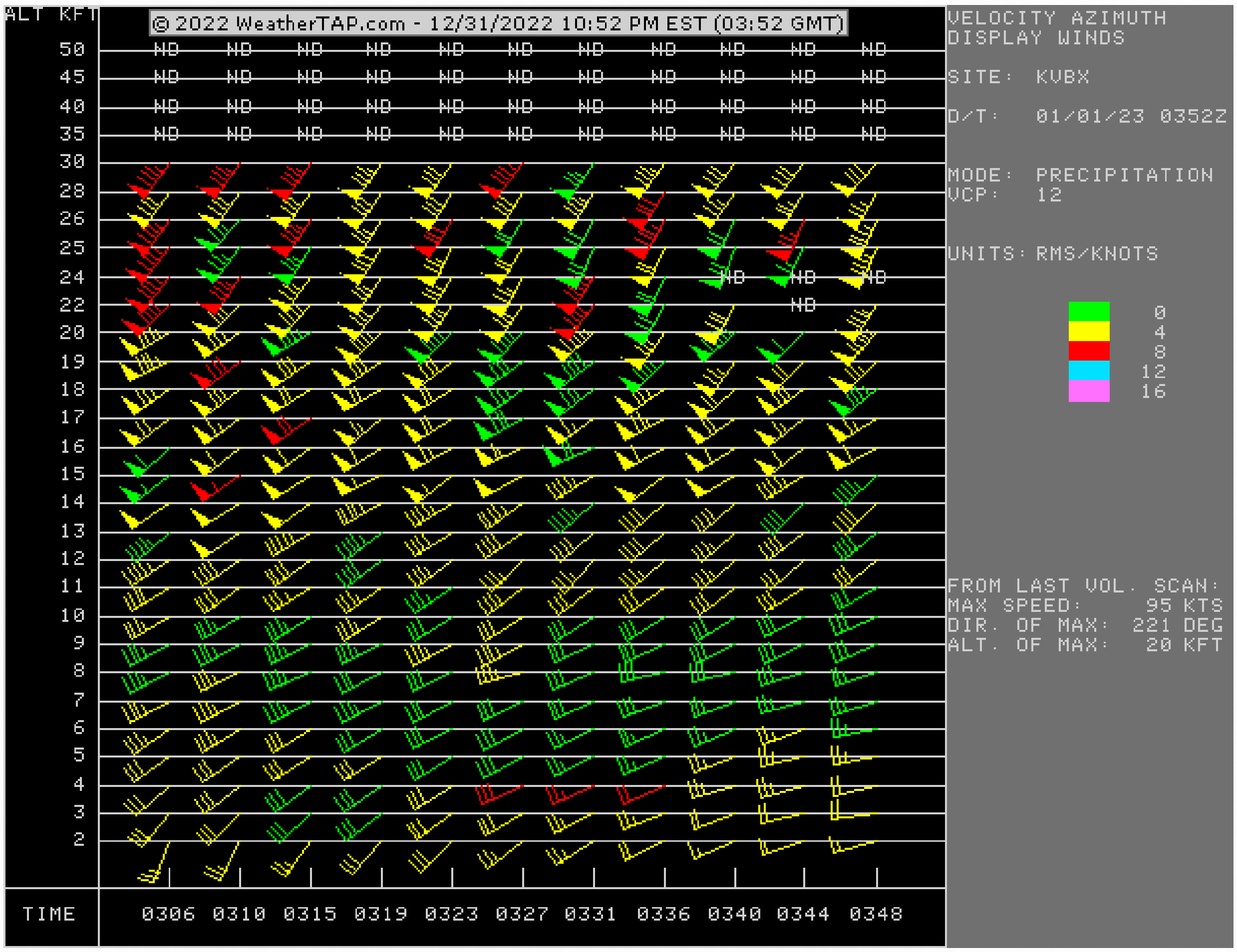

Figure 5.20 Radar VAD wind profile ending at 1848 PST December 31

December 31 flare use summary

Arroyo Grande 1829, 1835, 1840, 1845, 1850, 1855, 1859 PST

January 4-5, 2023

A large and powerful storm system developed in the eastern Pacific on January 4. The satellite image in Figure 5.21 shows this impressive system as it developed. Strong southerly winds accompanied a broad band of stratiform precipitation that affected the area on the evening of January 4 and overnight. The temperature was quite warm initially with the -5°C level well above 10,000 feet, and winds approaching 50 knots down to near the surface. Seeding was not conducted with this initial band as the meteorological parameters (temperatures, winds, precipitation type) were not favorable. Figure 5.22 is a radar image of this precipitation band as it moved into the area on the evening of January 4.

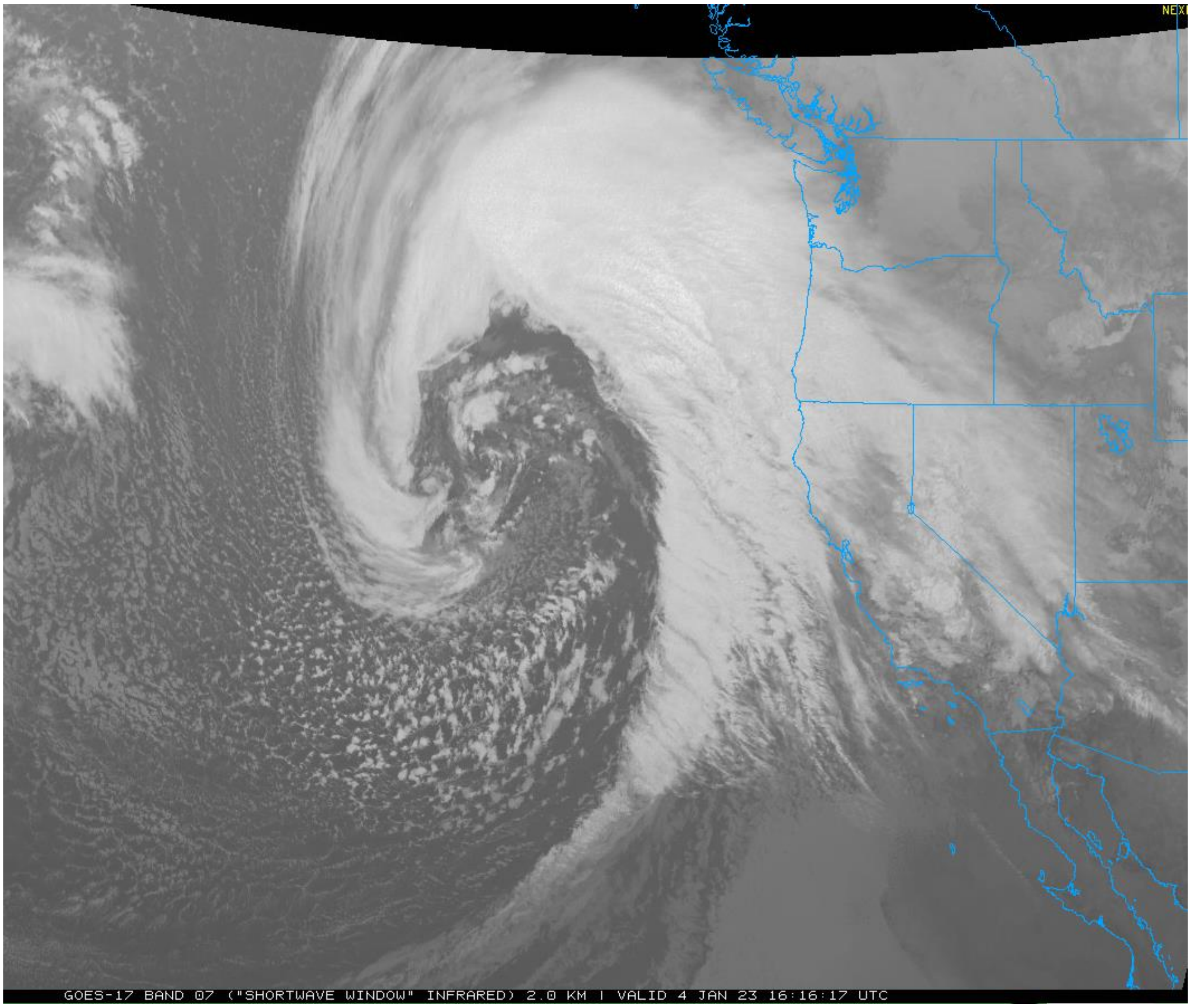

Figure 5.21 Infrared satellite image of developing storm on January 4

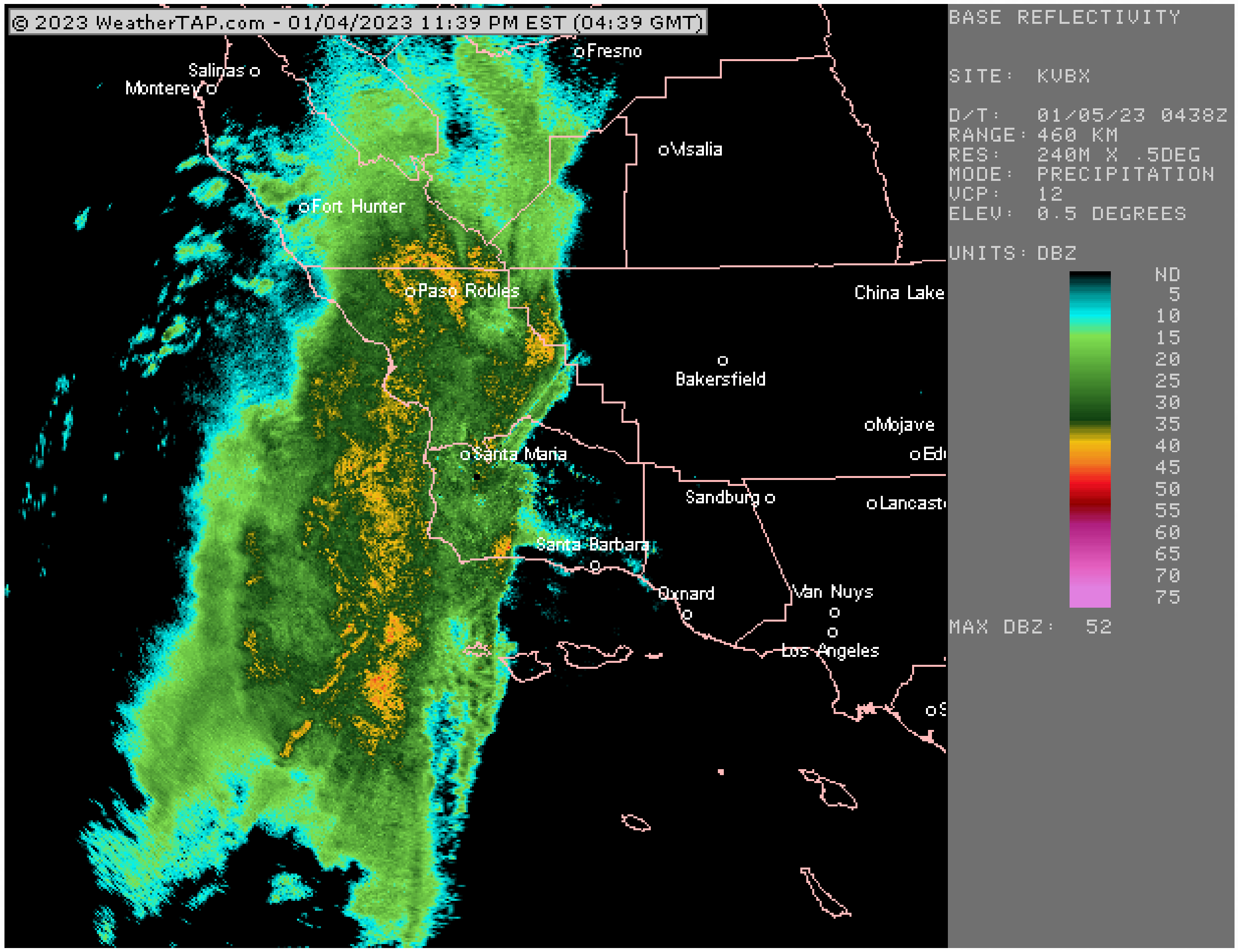

Figure 5.22 Vandenberg radar image at 2039 PST January 4

Following this initial heavy precipitation band, there was a break in the activity followed by more convective type precipitation on January 5. A seeding flight was initially launched late morning (1000 PST) but did not find anything suitable for seeding. However, a significant convective precipitation band (Figures 5.23 and 5.24) provided an opportunity for both ground-based seeding from the Arroyo Grande site as well as aircraft seeding. A total of five flares were used at the AG site from about 1230 – 1330 PST, as well as three aircraft flares targeting the Lopez Lake area during this time period. The aircraft was targeting both the Twitchell area (bordering Santa Barbara and San Luis Obispo counties) and the Lopez Lake area, so seeding flares used were divided between these two areas. Figure 5.25 shows the aircraft track during this event.

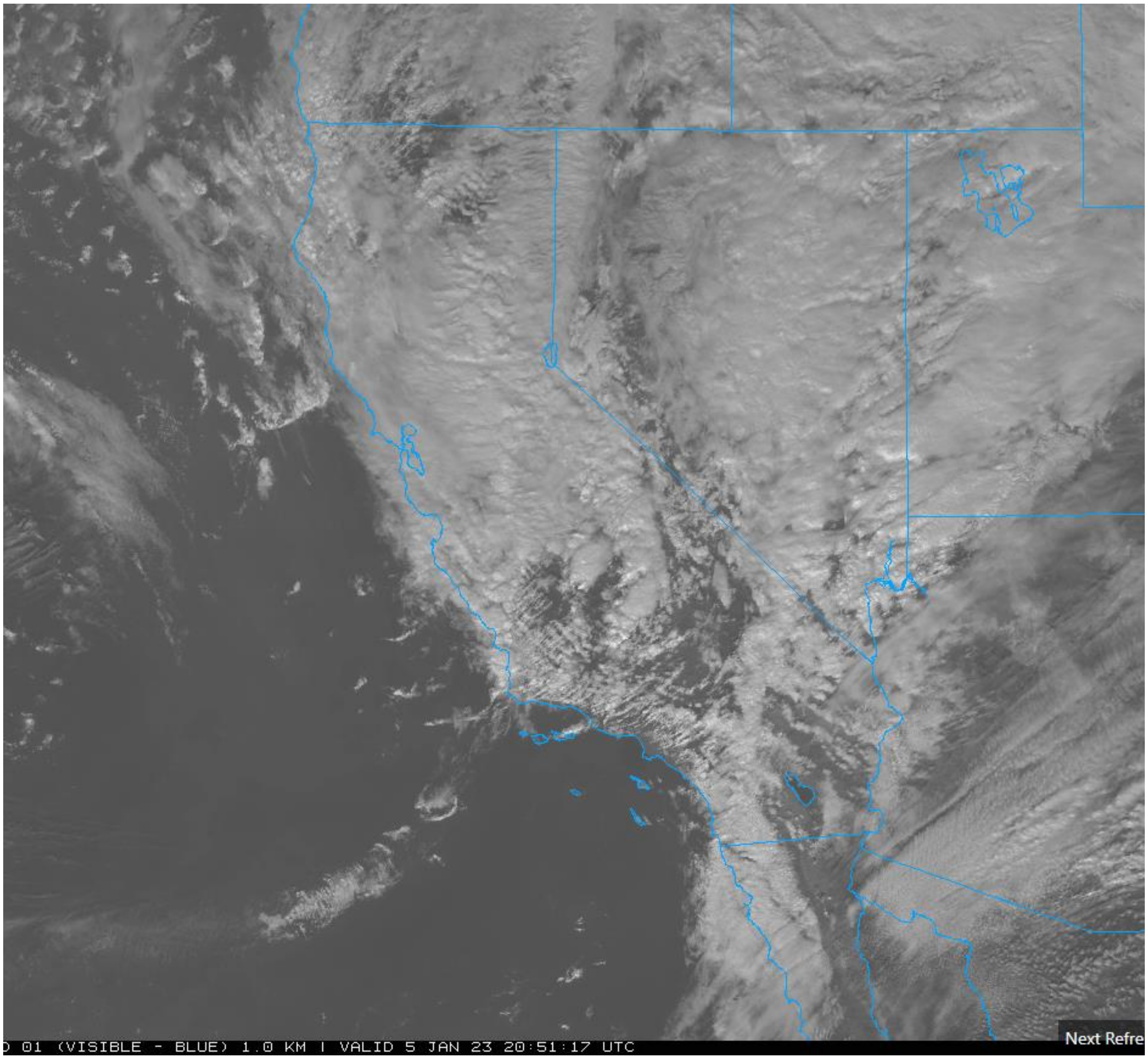

Figure 5.23 Visible spectrum satellite image at 1251 PST January 5

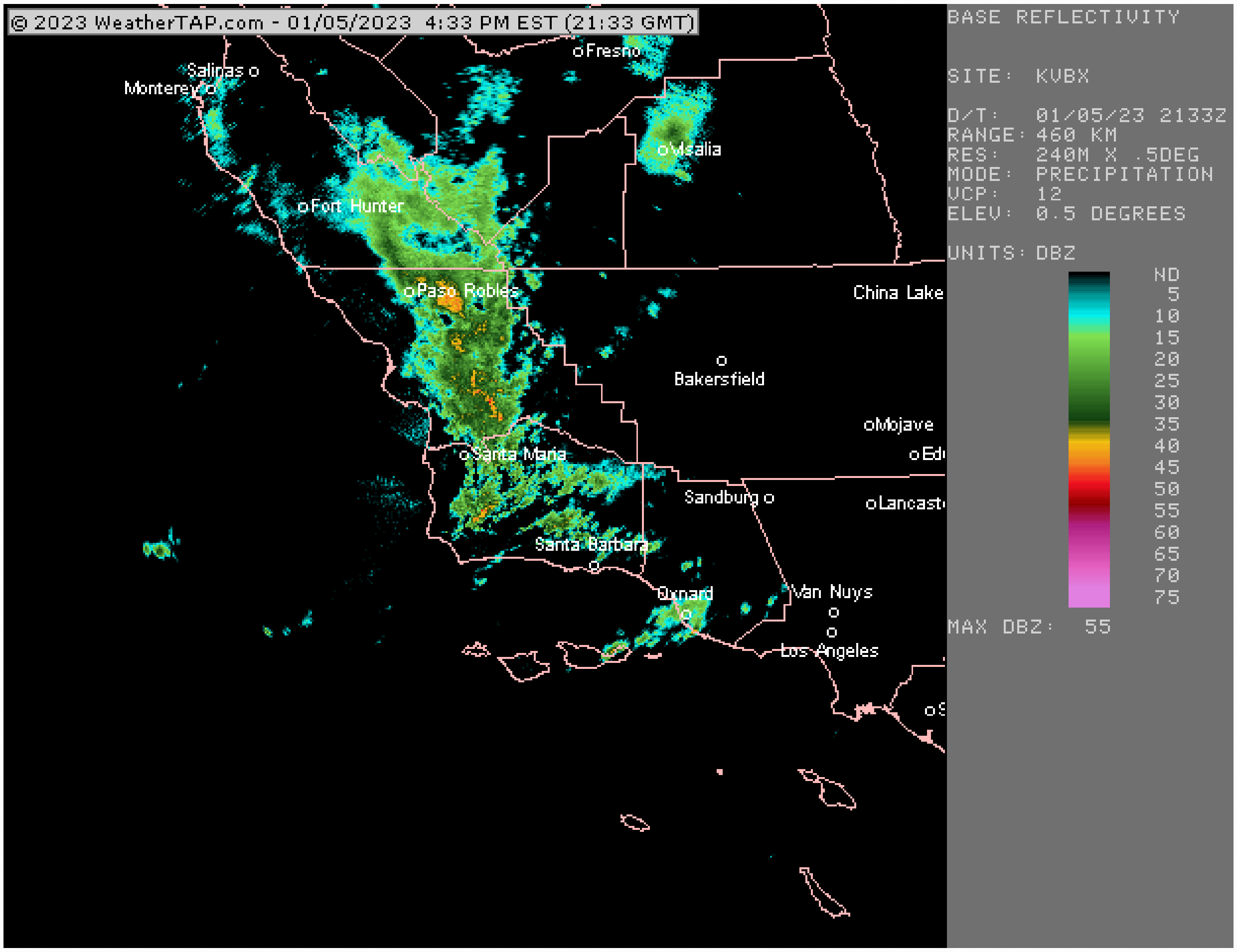

Figure 5.24 Vandenberg radar image at 1333 PST January 5

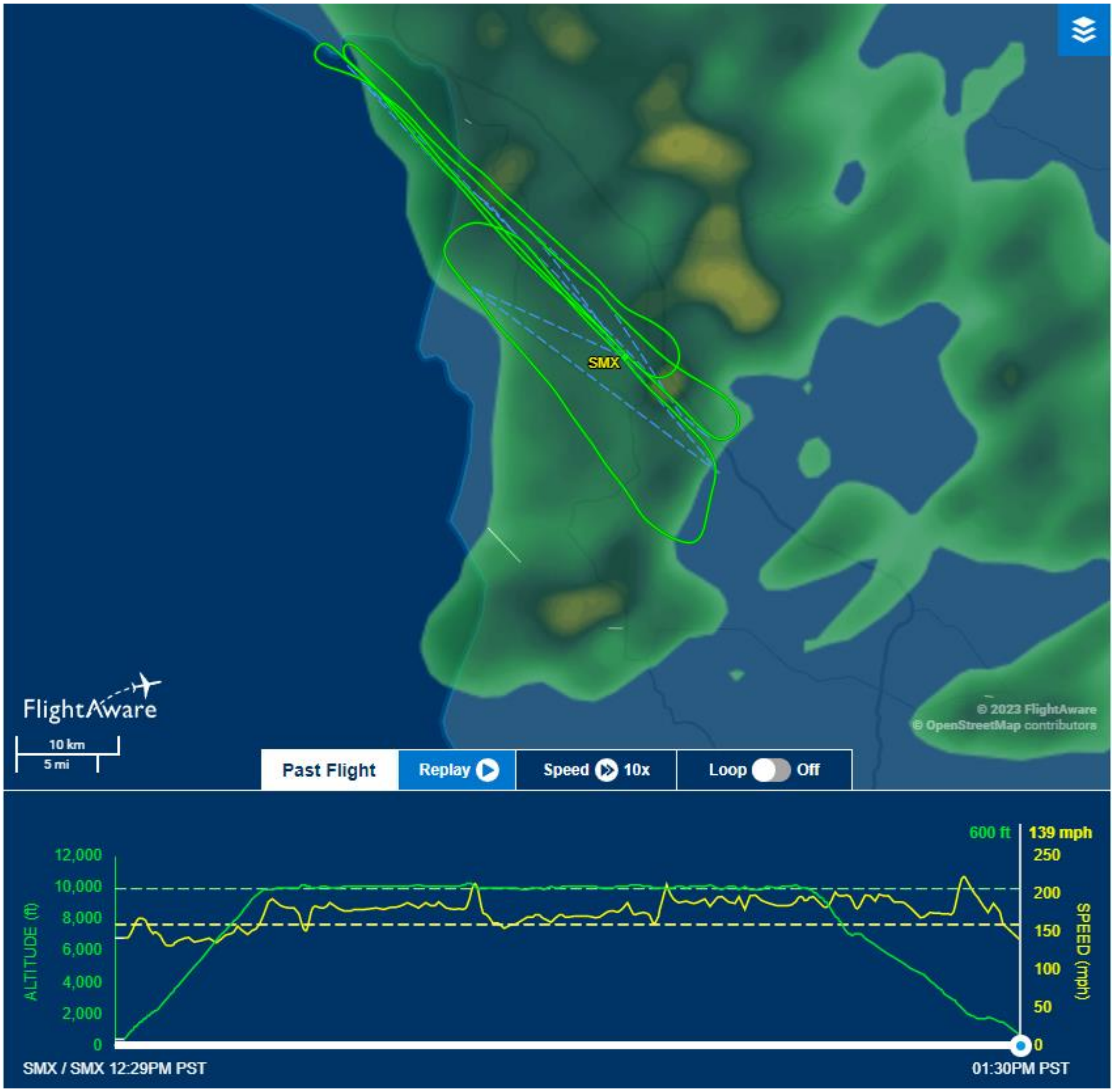

Figure 5.25 Aircraft flight data from 1229 – 1330 PST January 5

Figure 5.26 shows rainfall totals for the January 4-5 storm event, which were generally near to above two inches.

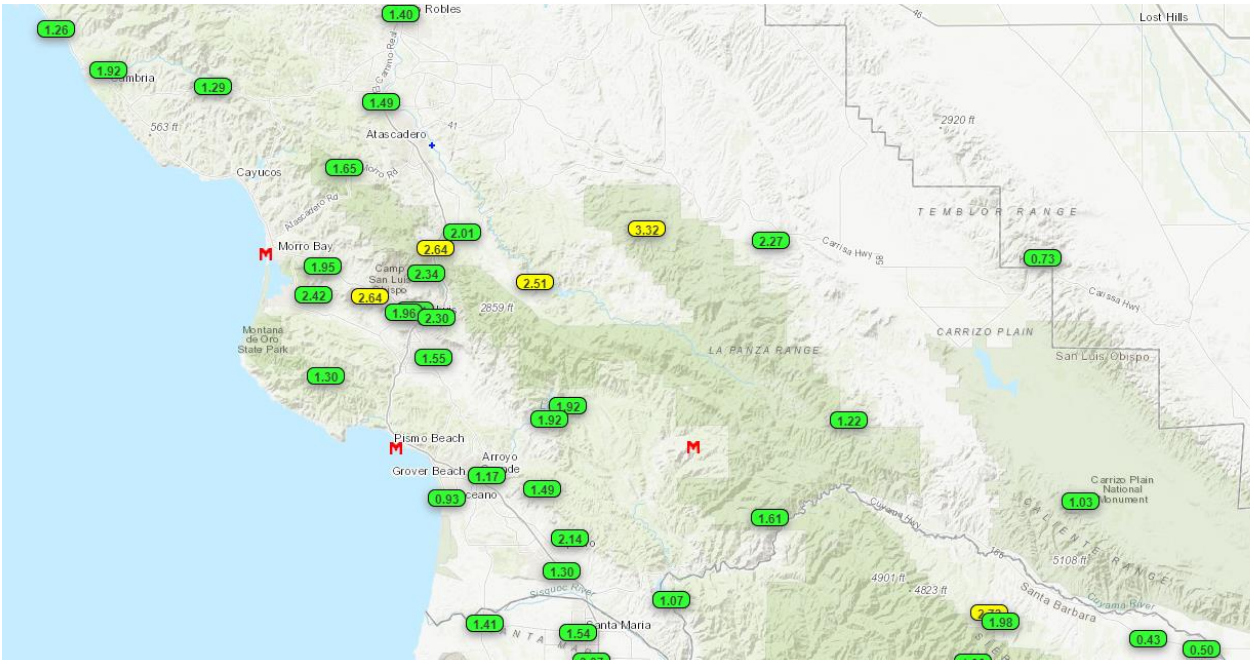

Figure 5.26 Regional rainfall totals for the January 4-5 event

January 9-10

An exceptional rainfall event affected the region on January 9, with a deep and vigorous trough in the eastern Pacific bringing a large band of subtropical moisture across the area. Figure 5.27 is a satellite image early in this event. Due to deep moisture and a strong southerly wind field, rainfall rates became quite heavy especially in areas where the terrain is oriented west-east. Rainfall rates approached an inch per hour in some of these areas (see Figures 5.28 and 5.29). The snow level rose to near 9,000 feet during this heavy rainfall period with a warm air mass associated with this moisture band.

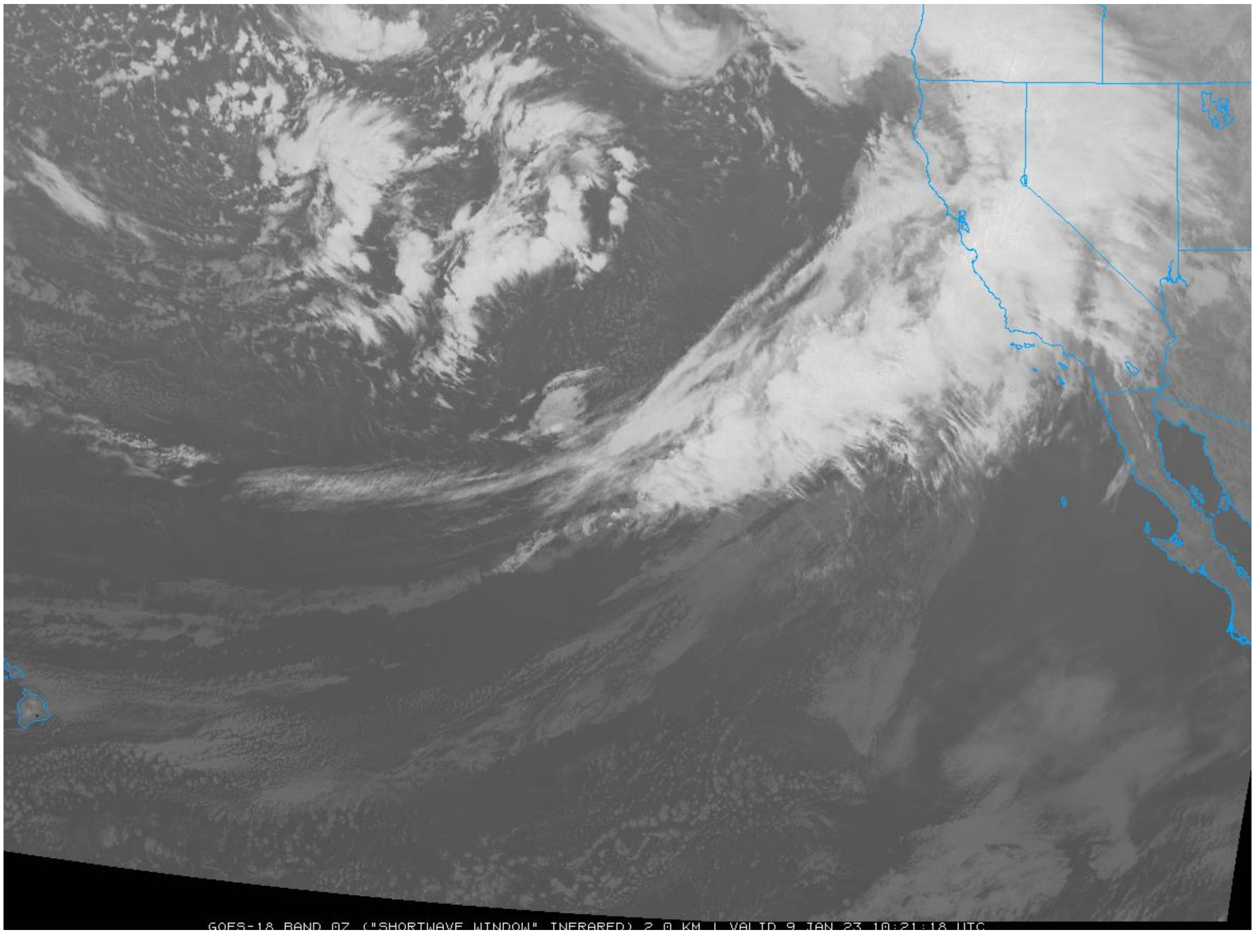

Figure 5.27 Infrared satellite image at 0221 PST January 9

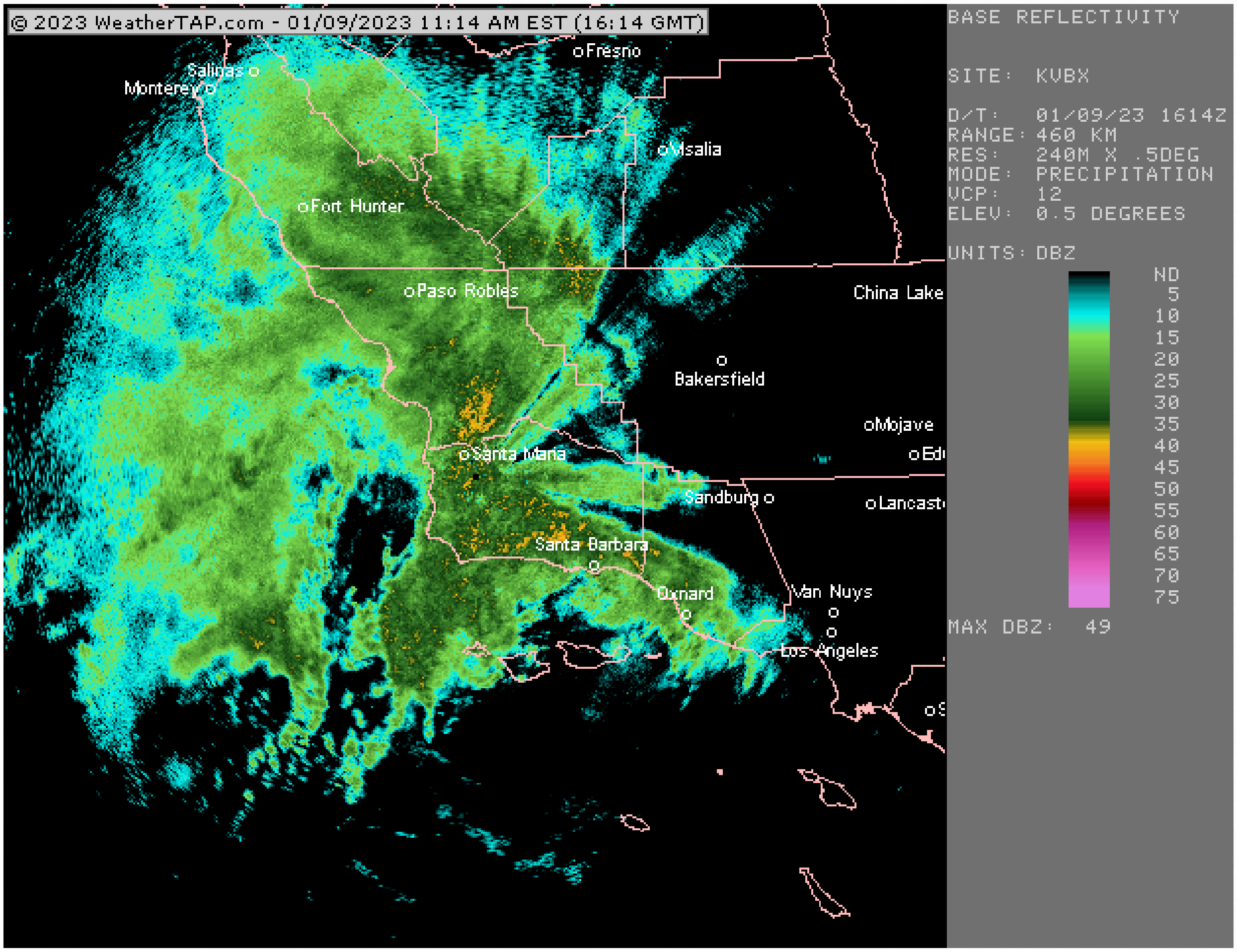

Figure 5.28 Vandenberg radar at 0814 PST January 9 during the primary rainfall event

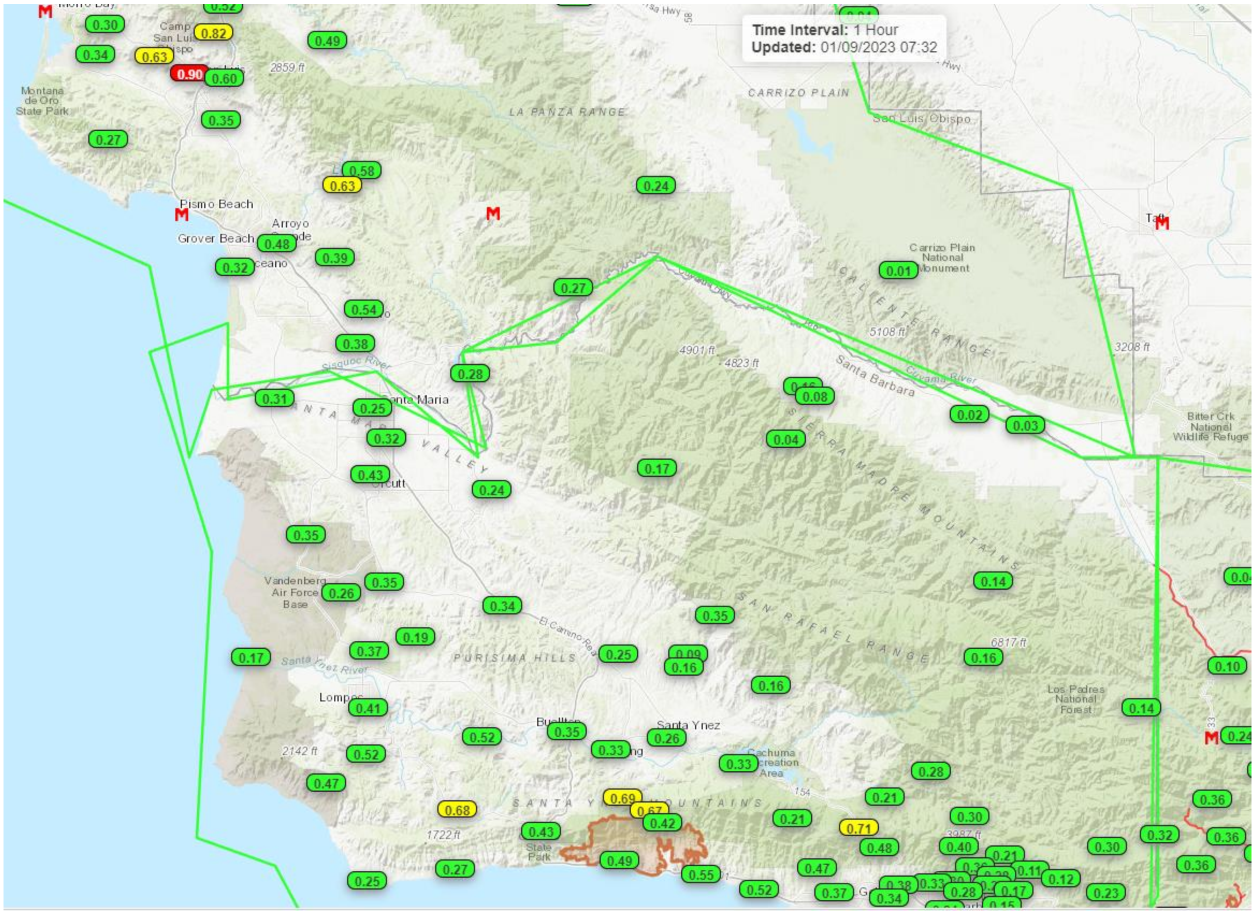

Figure 5.29 Hourly rainfall ending at 0630 PST on January 9

The heavy rainfall on January 9 continued most of the day, ending during the evening hours. Rainfall totals in the 12 to 24-hour time period were comparable to 25-50 year return period values for much of SLO County for an event of this duration. This period of rainfall generated large amounts of runoff and widespread flooding, with flood warnings issued by the NWS by late morning on January 9 affecting the seeding target area. Although conditions were not meteorologically favorable for seeding during this primary storm period (due to warm temperatures, strong winds and lack of convective activity), by late morning on the 9th any potential seeding operations were suspended due to flooding and exceedance of suspension criteria.

On the night of January 9-10, the core area of this deep trough remained over the Pacific and this subsequently produced a fast-moving convective band during the early morning of January 10 (see Figures 5.30 and 5.31), followed by rapidly decreasing convective showers. However, seeding remained suspended during this period as flood warnings had not yet expired, and there were no operations conducted during the January 9-10 storm period. Following this event, seeding remained suspended for the remainder of January.

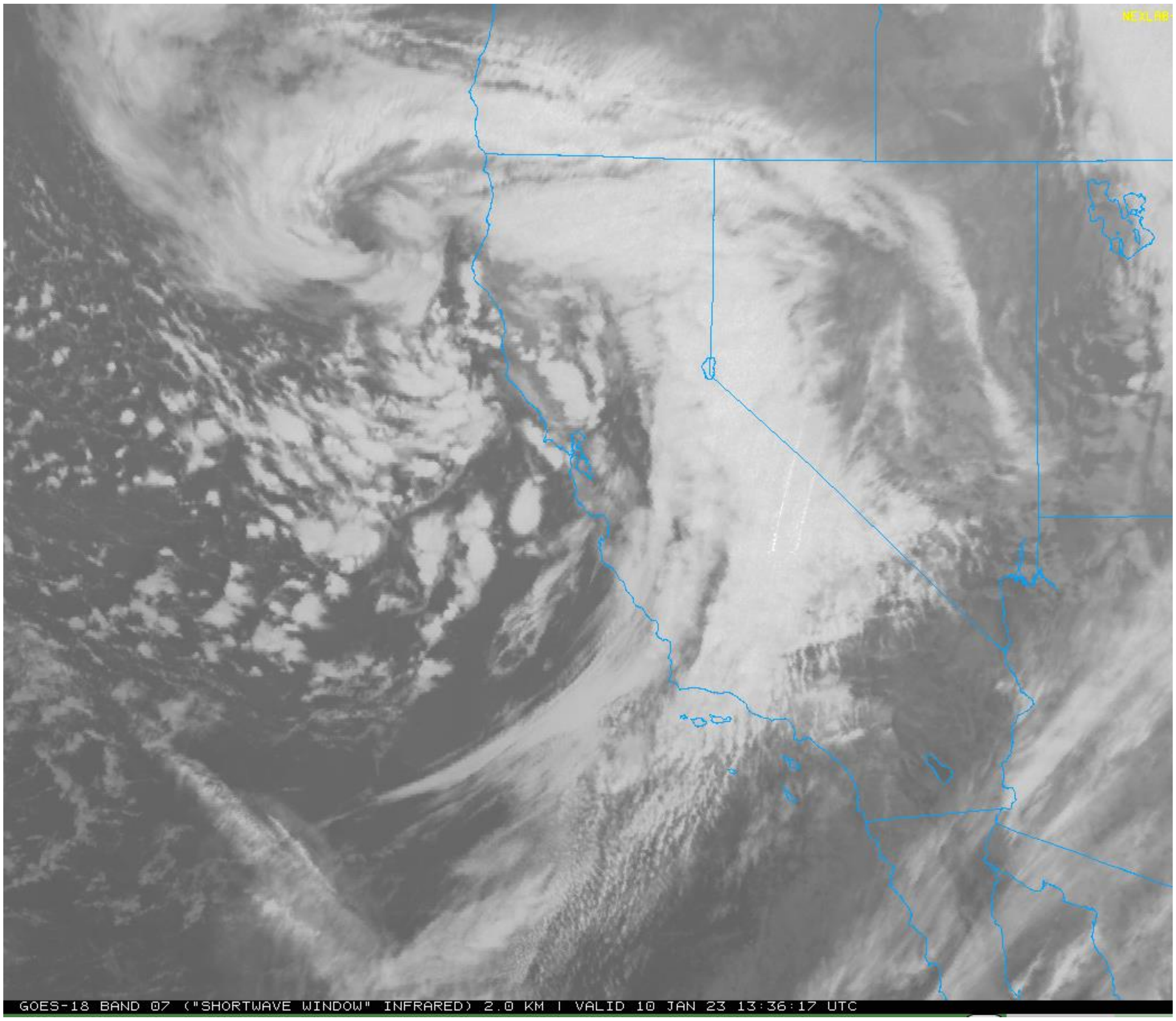

Figure 5.30 Infrared satellite image at 0536 PST January 10

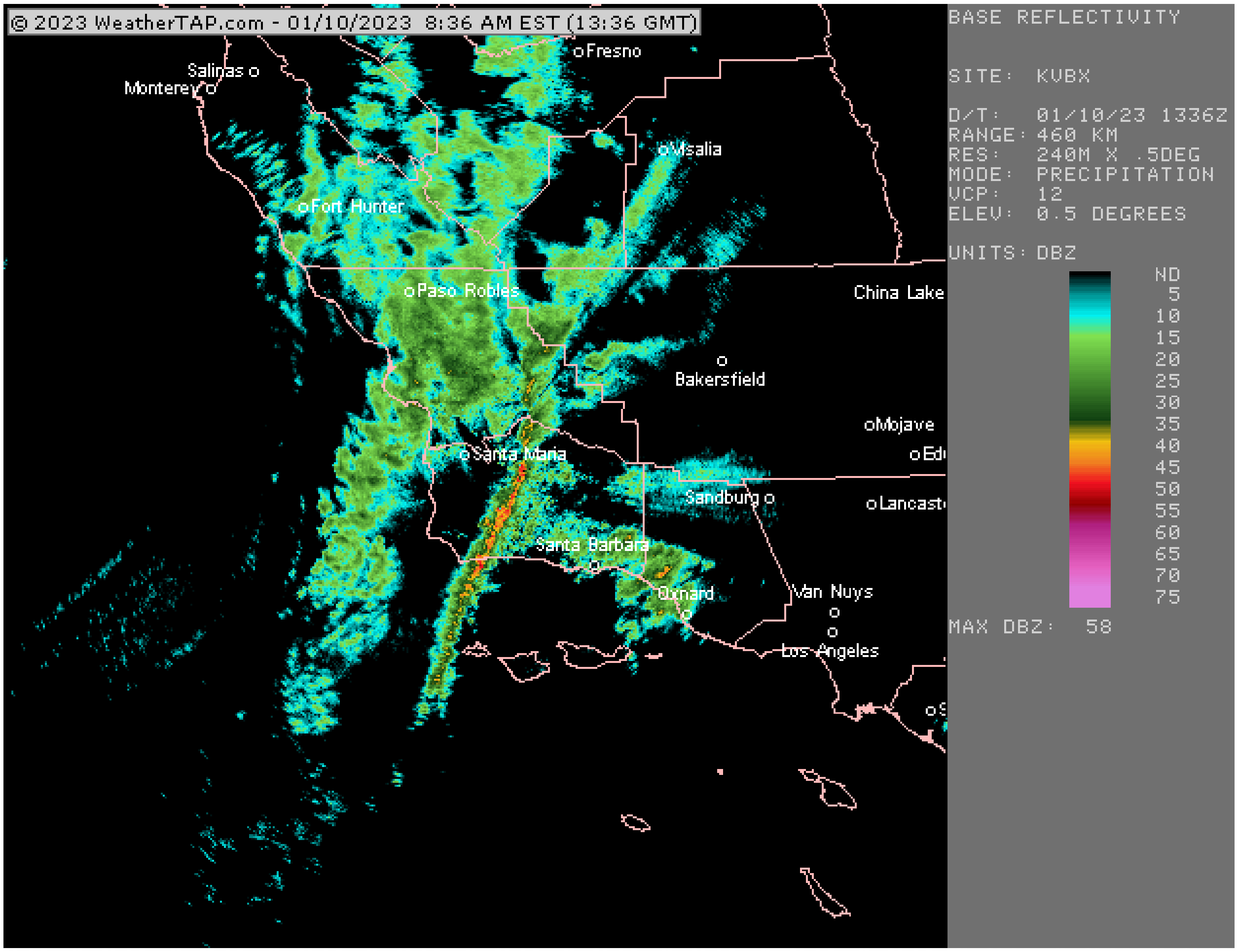

Figure 5.31 Vandenberg radar at 0536 PST January 10

Figure 5.32 shows 24-hour rainfall totals for January 9. Additional rainfall on the 10th was generally near to under an inch.

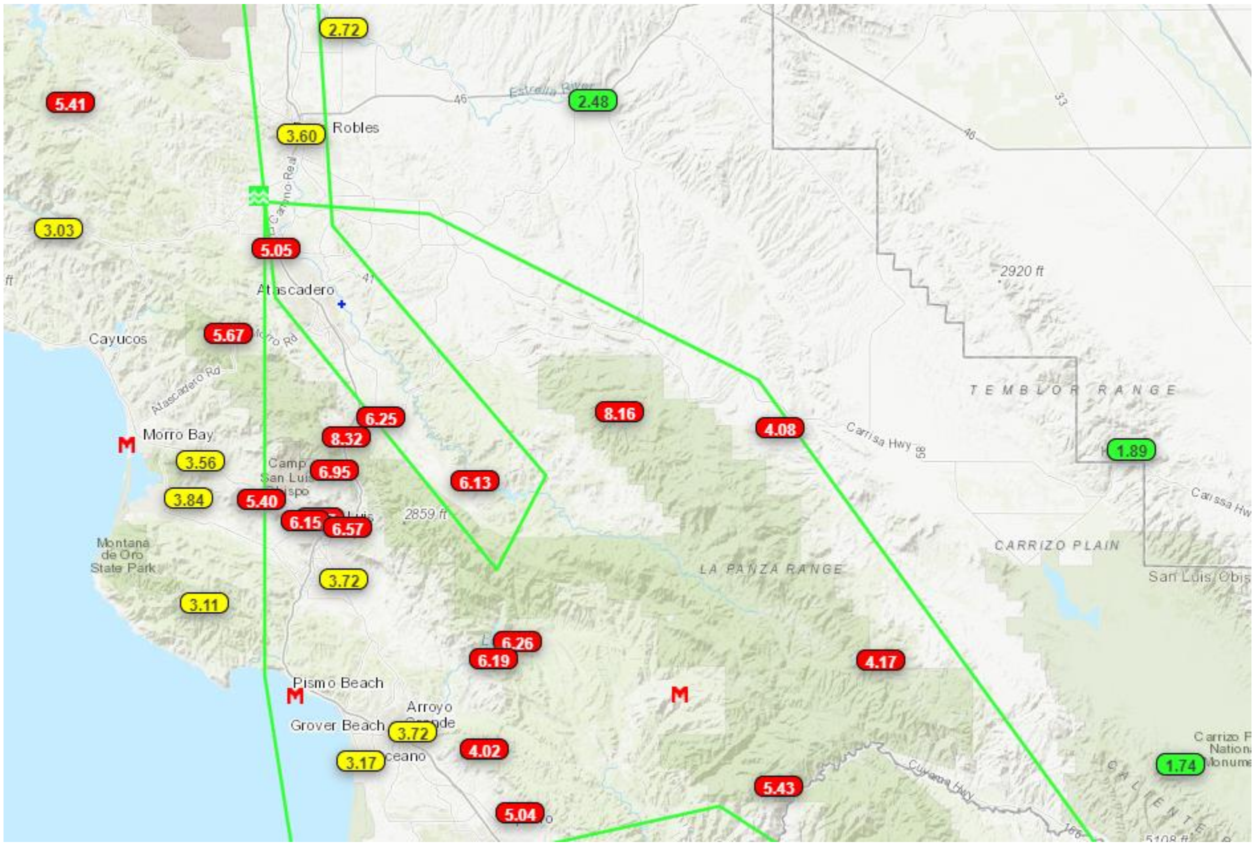

Figure 5.32 24-hour rainfall for January 9; totals in red exceed 4 inches

Following the January 9-10 event, there was another series of storms in mid-January (mostly January 14-16) and one other significant event on January 29. No seeding operations occurred for the Lopez Lake area as the program remained suspended.

Note that seeding remained suspended for the February and March storm periods as well, although significant storm events for the remainder of the season are still briefly summarized.

<u>February 4-5</u>

A minor storm event affected the area on the night of February 4-5, with rainfall totals near a half inch in most mountainous areas. This event consisted of shallow clouds in the tail of a frontal system and was mostly a "warm" rainfall event, with much o f the precipitation forming at very low elevations that were well above freezing. There were a couple of precipitation bands that crossed the area during this time period with generally light rainfall rates, except briefly moderate in some terrain favored areas.

Figure 5.33 is an infrared satellite image late on the evening of February 4, showing the double banded structure in the tail end of the frontal zone that affected the area. Figure 5.34 is a radar image shortly after midnight, and Figure 5.35 is a map of rainfall totals from this event.

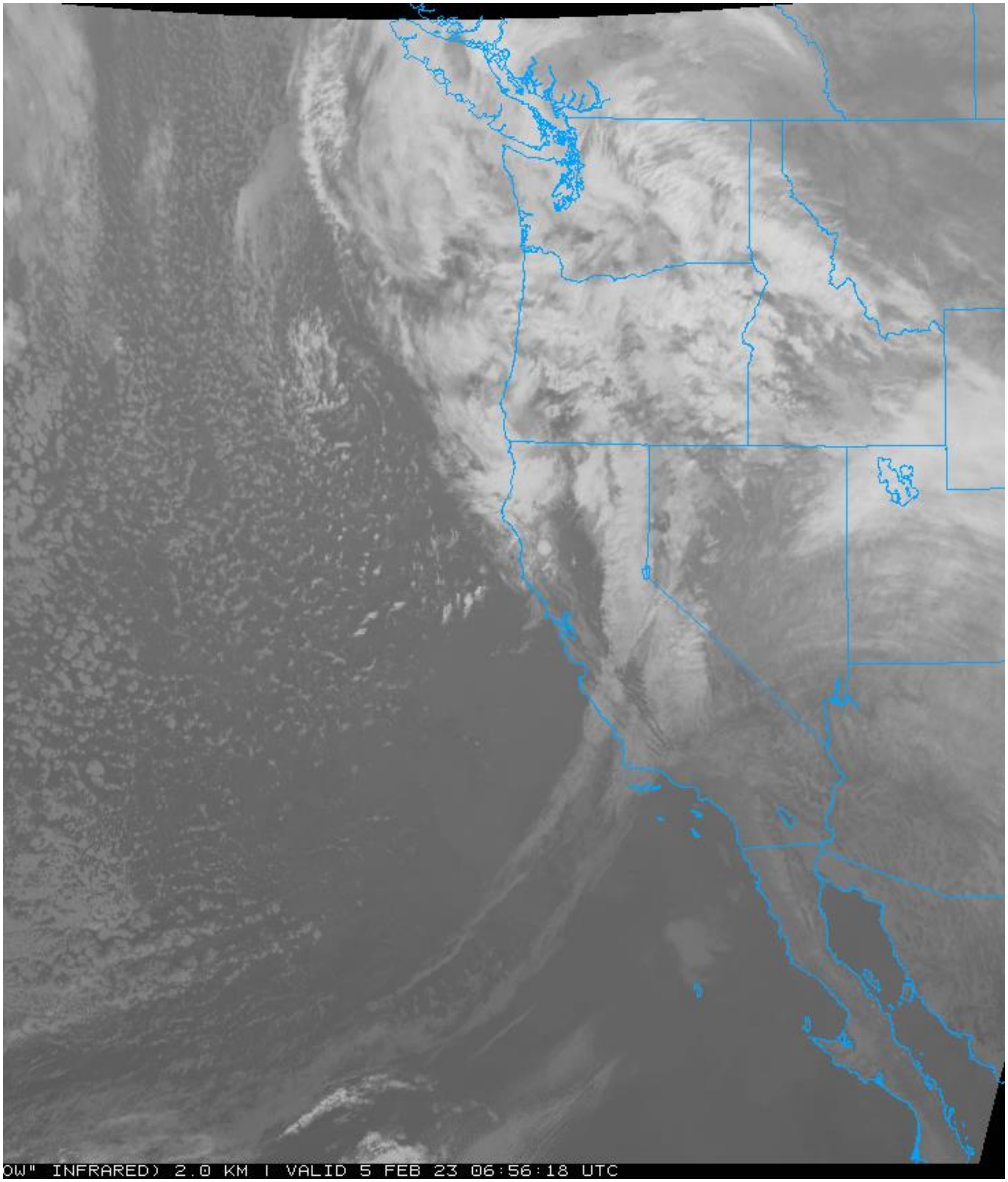

Figure 5.33 Infrared satellite image at 2256 PST Feburary 4

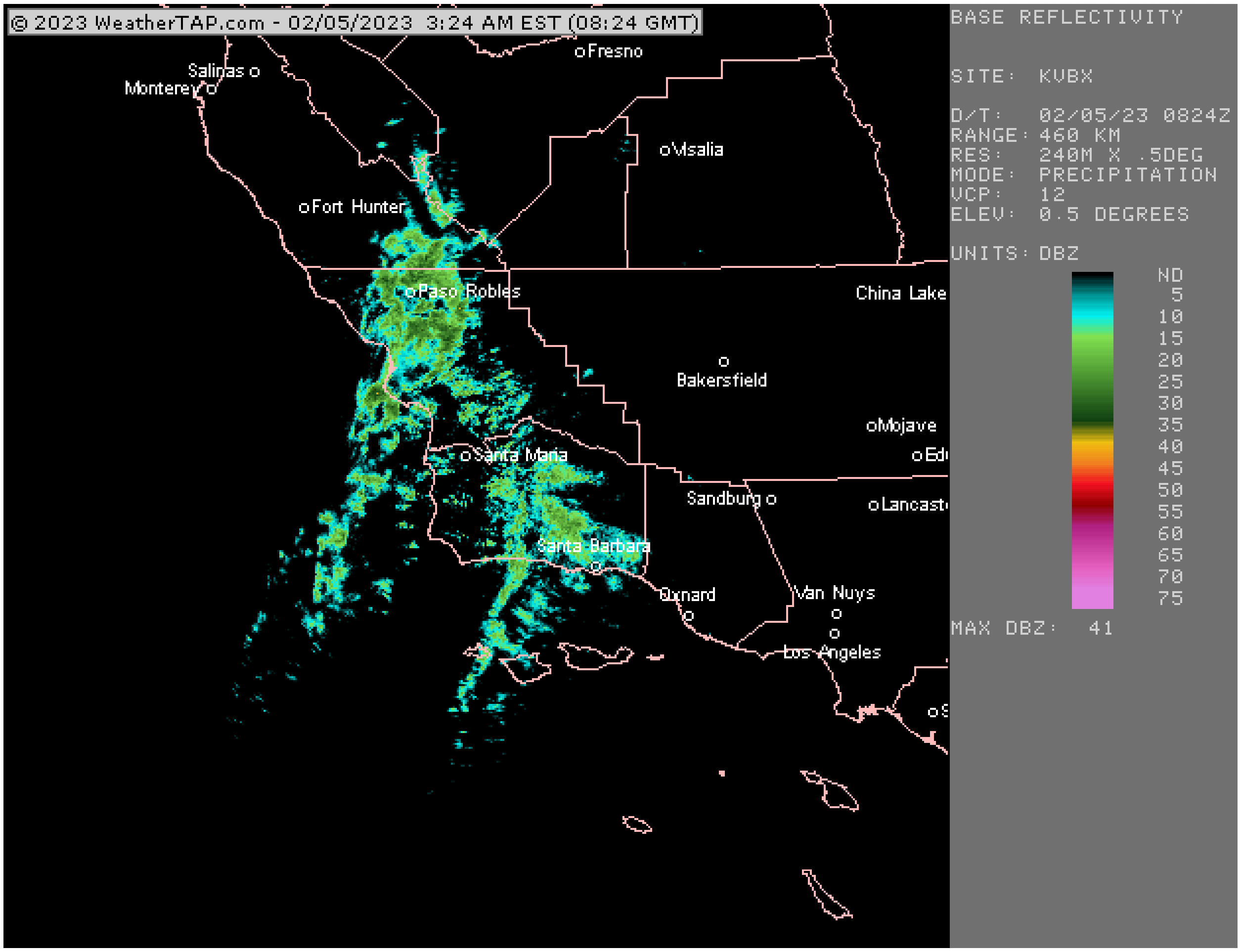

Figure 5.34 Vandenberg weather radar image at 0024 PST February 5

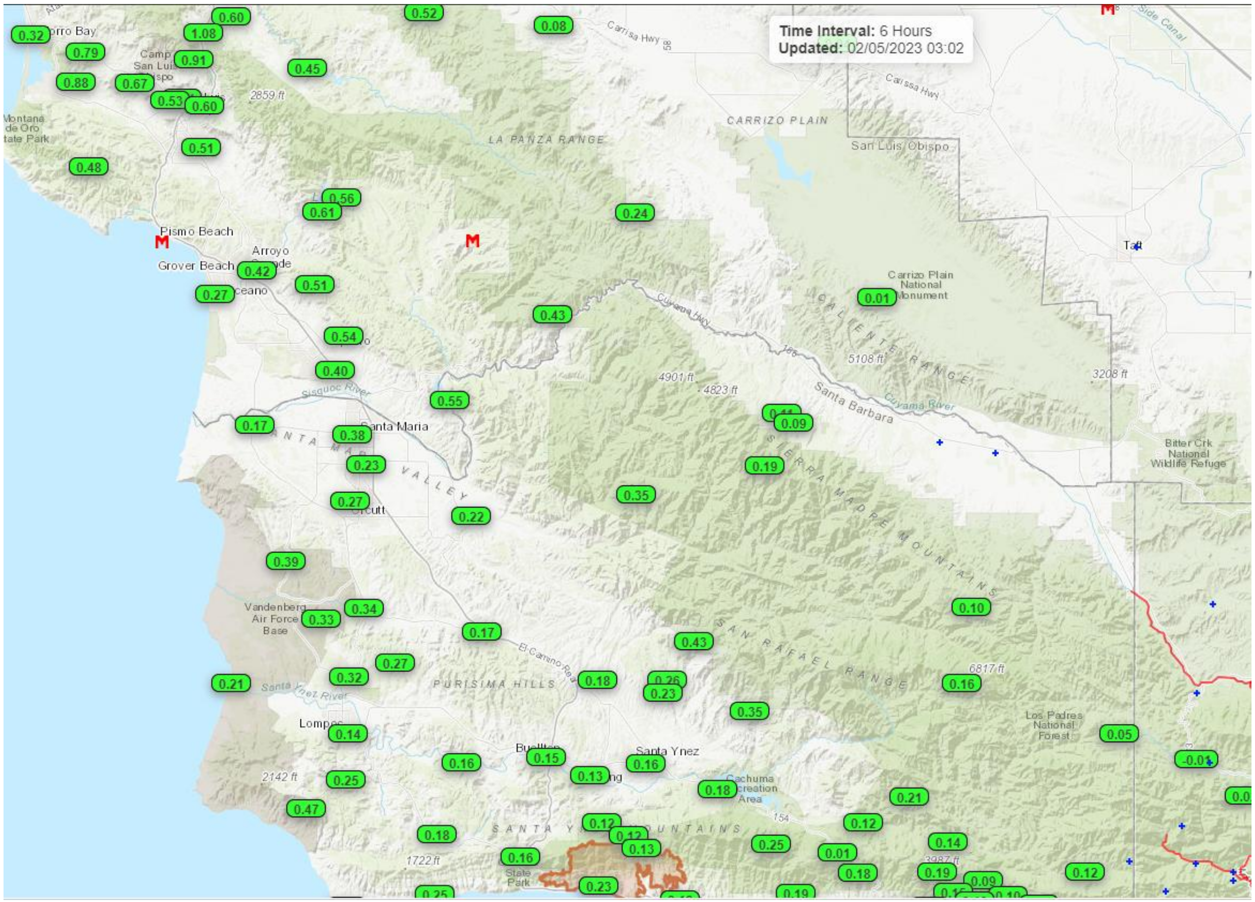

Figure 5.35 Rainfall totals on the night of February 4-5

February 23-25

After a period of dry weather, a very deep and cold trough of low pressure with Arctic origins affected all of the western U.S. during the February 23-25 time period. This trough developed a closed circulation center that began near the Oregon coast on February 23 and dropped southward to near southern California by February 25. This trough contained an abnormally cold air mass and developed into a large and vigorous closed low that was very impressive in satellite imagery (Figures 5.36 and 5.37). Figures 5.38 – 5.41 are radar images during various precipitation band passages in this storm event. Much of the precipitation with this event was convective in nature and resulted in periods of moderately high precipitation rates. Also of note is the stratiform precipitation with a bright band signature (Figure 5.41) late on February 24, with an atypically low snow level near 2,500 feet at that time. Precipitation totals for the entire event were generally 3+ inches with localized totals to over five inches.

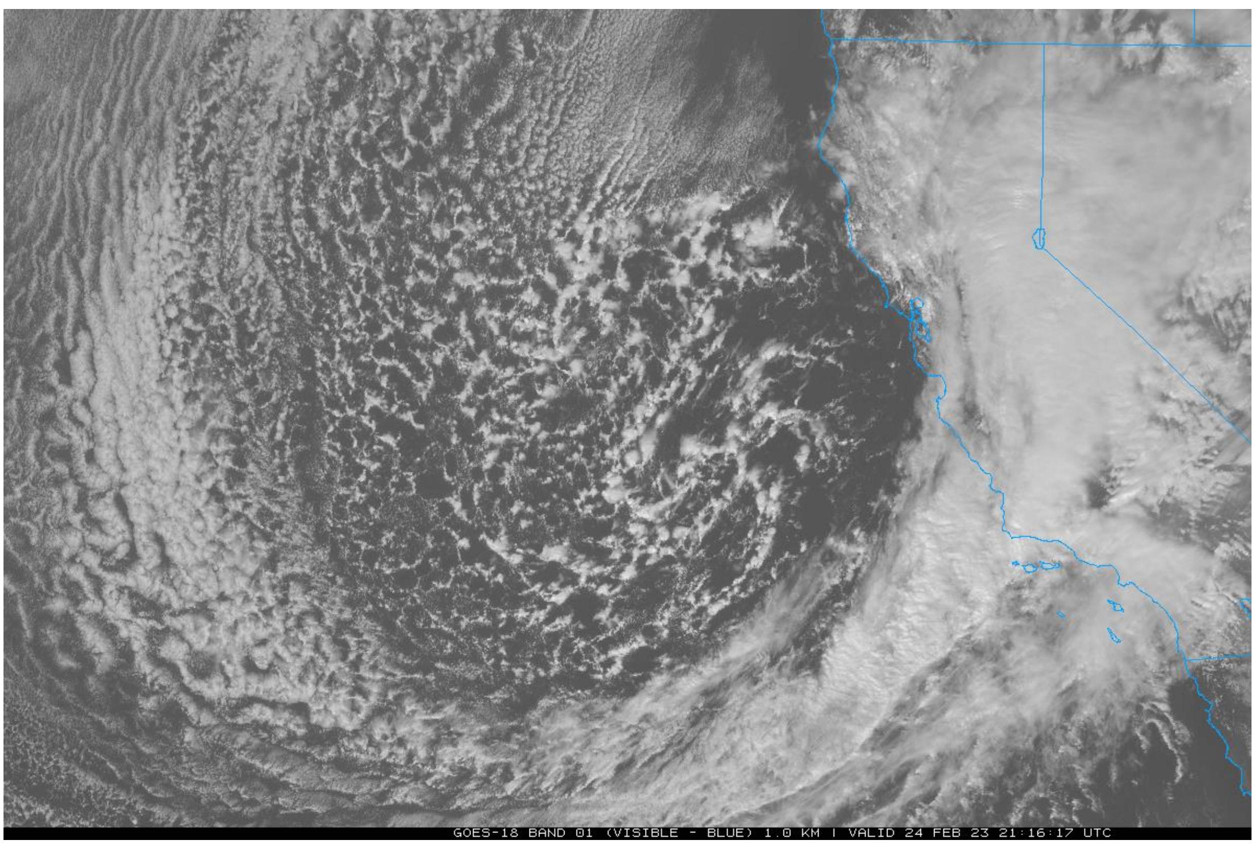

Figure 5.36 Visible spectrum satellite image at 1316 PST on February 24, with the closed low centered off the central California coastline.

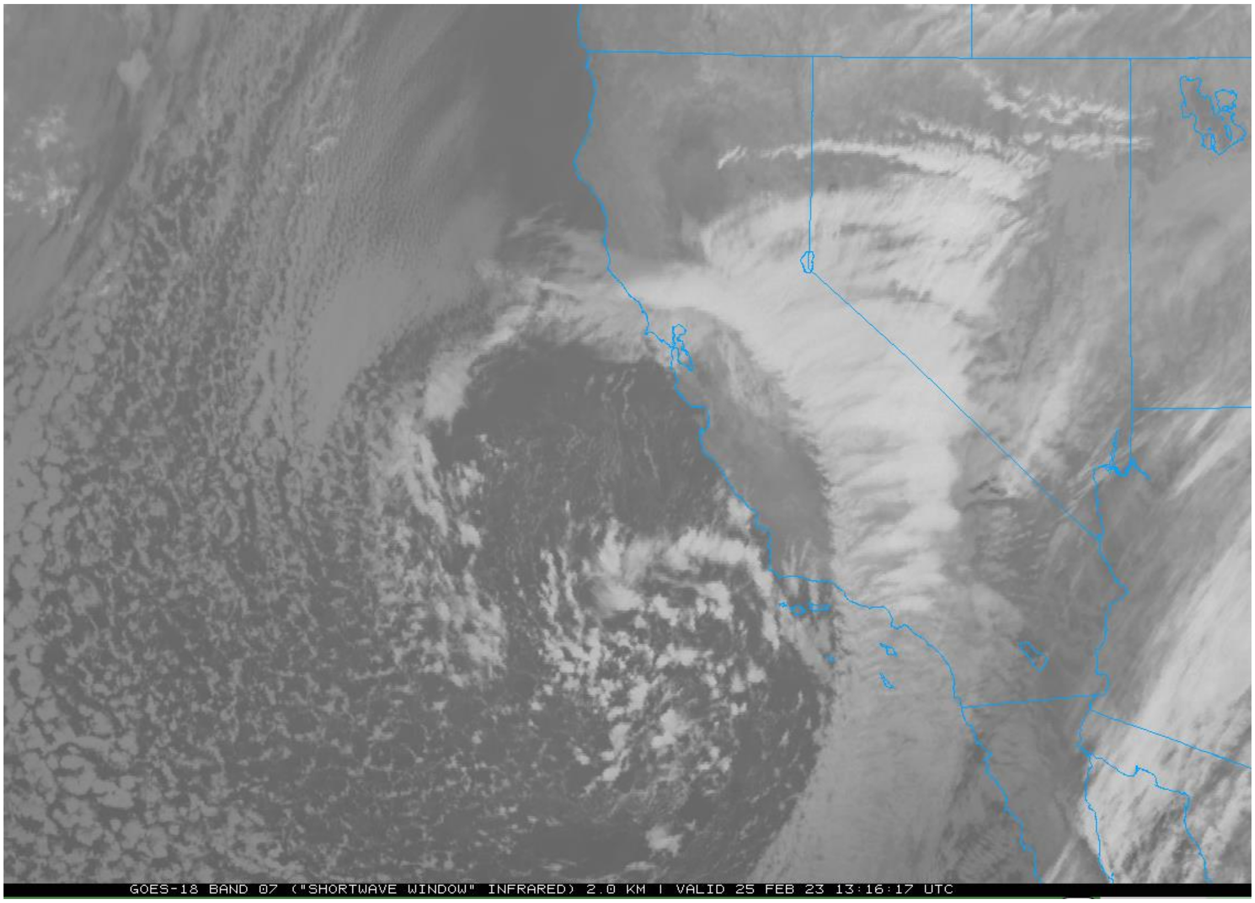

Figure 5.37 Infrared image at 0516 PST February 25, with the low center near southern CA coast

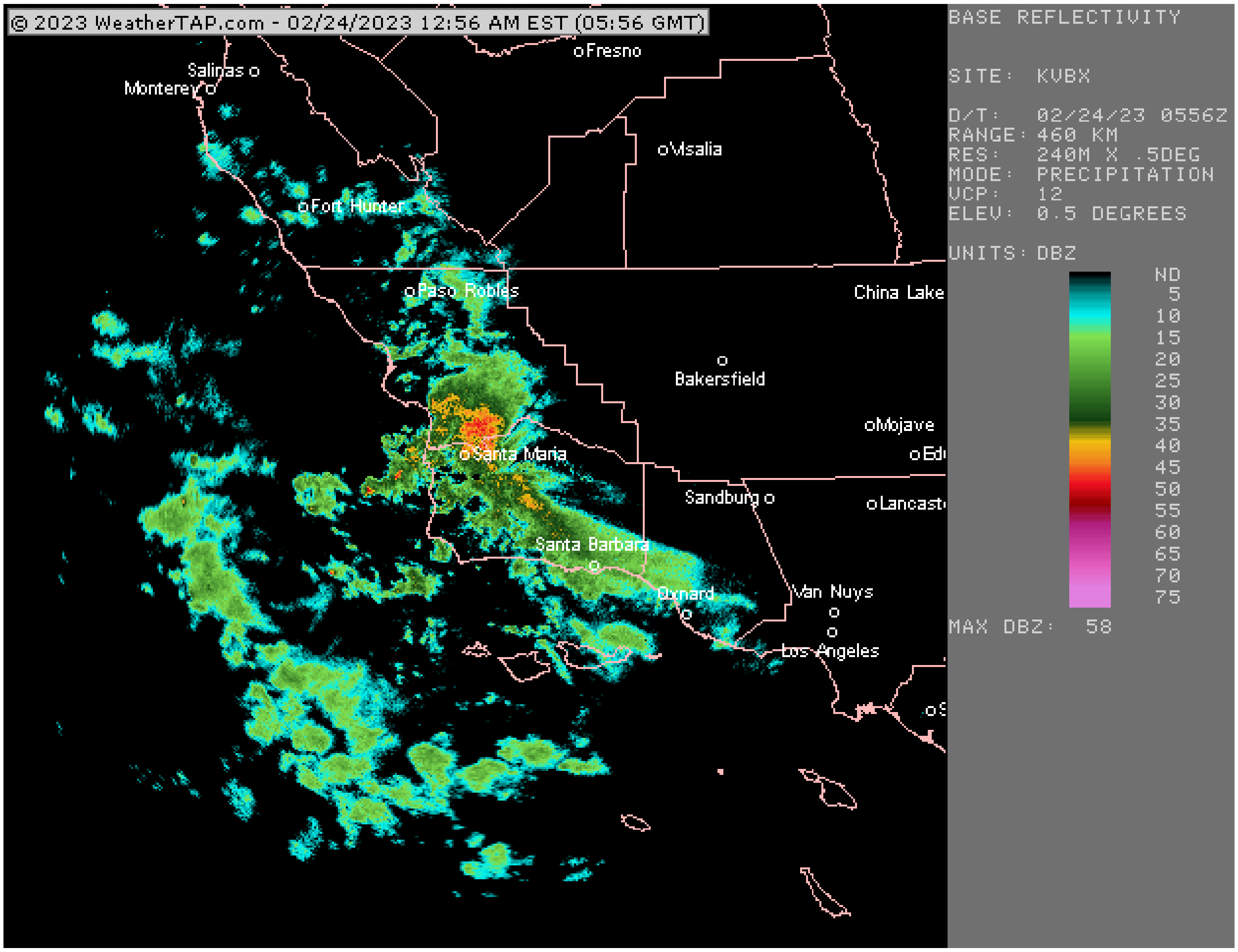

Figure 5.38 Vandenberg radar image at 2156 PST February 23

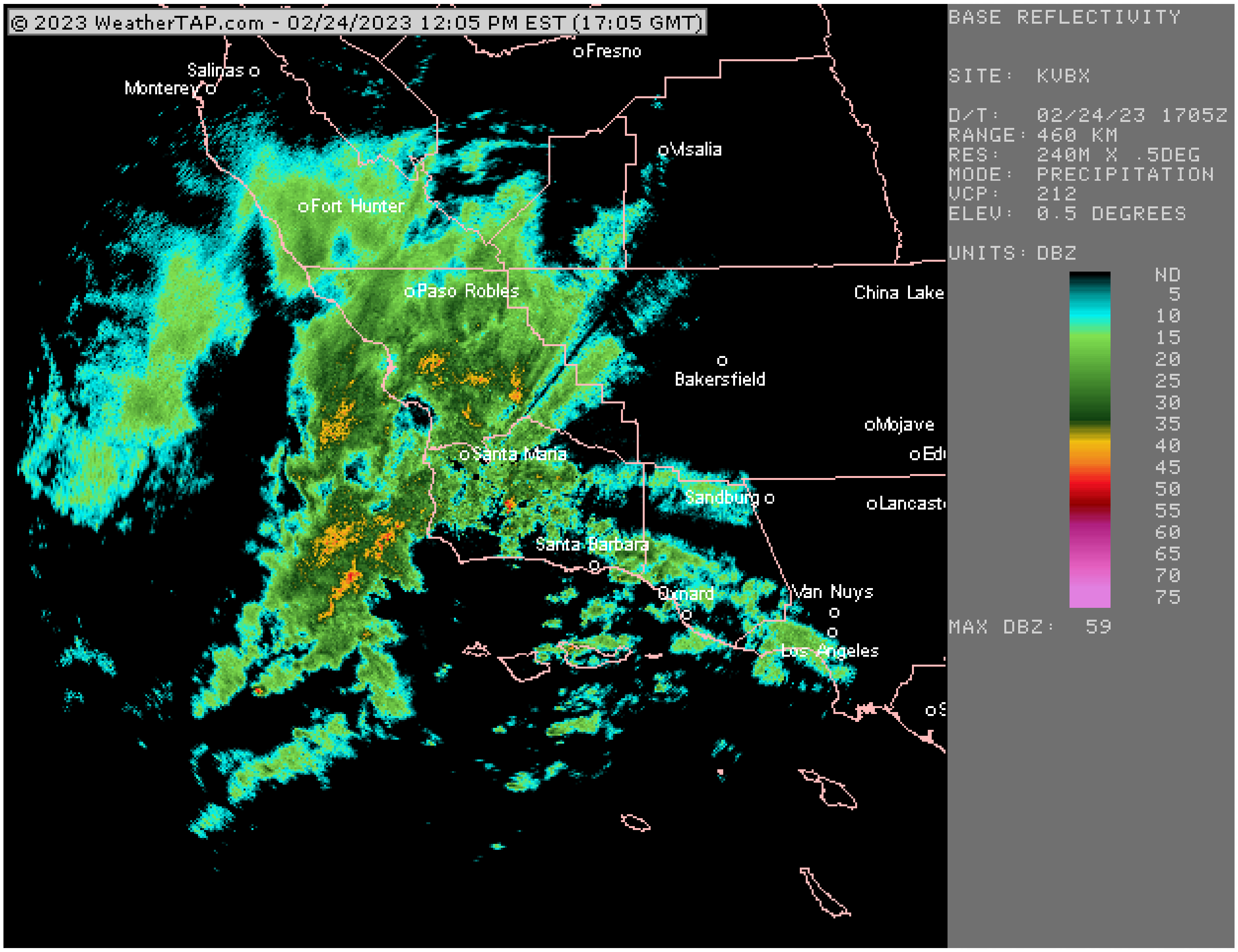

Figure 5.39 Vandenberg radar at 0905 PST February 24

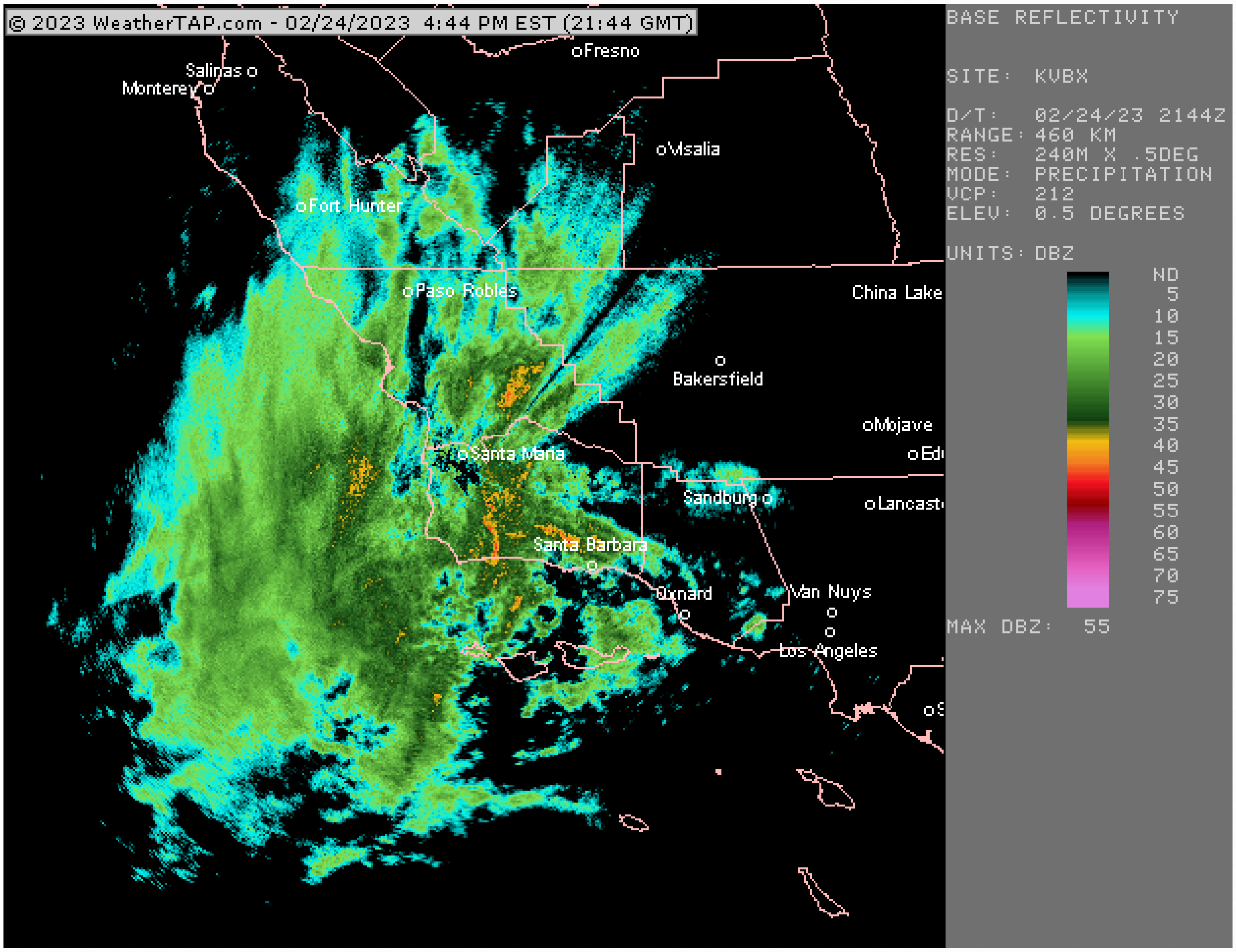

Figure 5.40 Vandenberg radar image at 1344 PST February 24

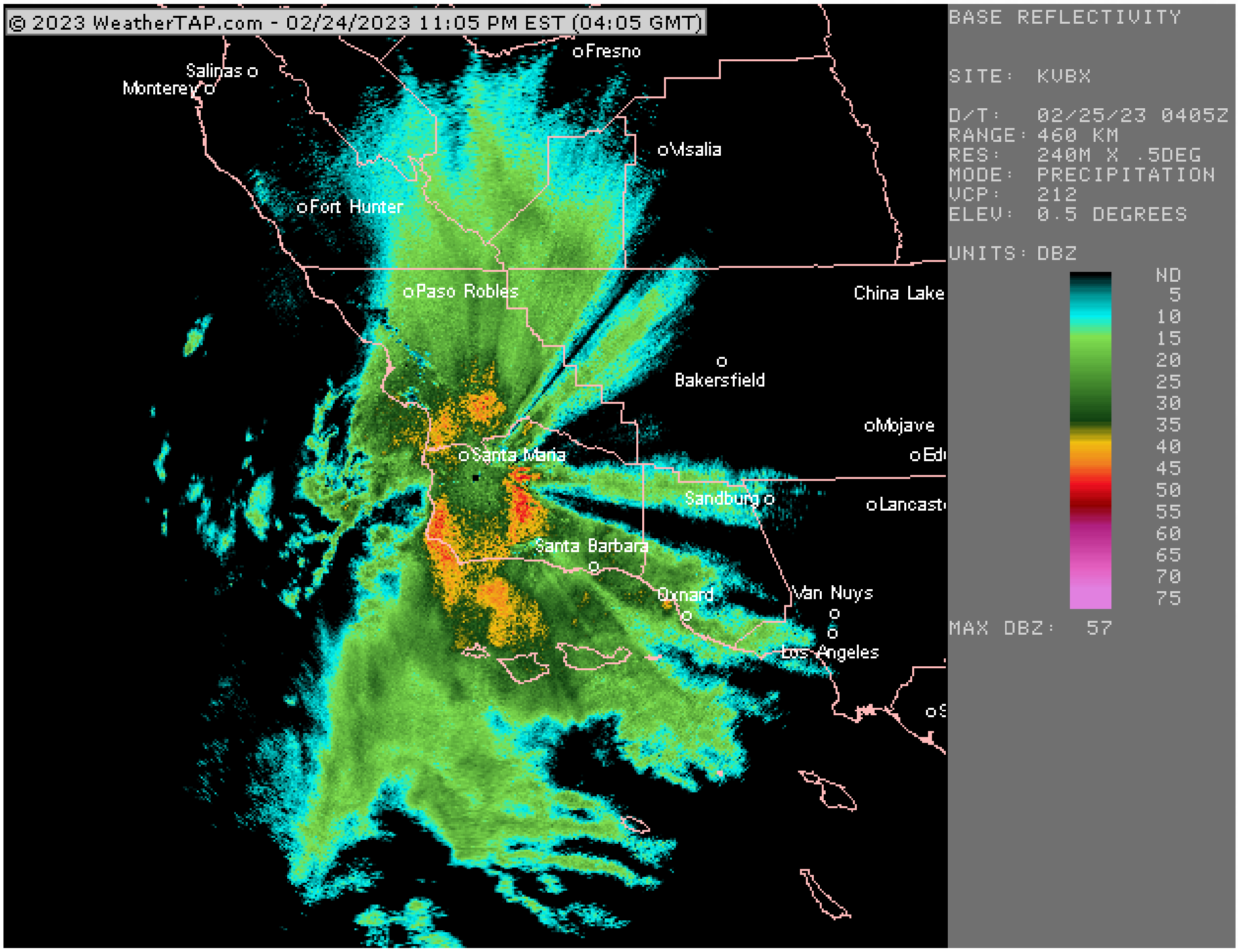

Figure 5.41 Radar image at 2005 PST February 24; a bright band is evidenced by the roughly donut-shaped area of higher reflectivity (yellow/orange)

February 27-28

Another very deep, cold trough affected the western U.S. during the February 27-28 period. Due to its more northerly position and weaker precipitation bands over central and southern California, precipitation totals were much more modest than in the previous storm period. This system, like the previous, contained an anomalously cold air mass originating in the Arctic, with the snow level falling to sea level over much of the northeastern Pacific extending down to the northern California coast. Figure 5.42 is a visible spectrum satellite image of this system on the afternoon of February 28, with a center located somewhere near the Oregon coast at that time. Figures 5.43 – 5.45 are radar images of various precipitation band passages during this event. Precipitation totals with the February 27-28 system averaged close to an inch in most mountains of San Luis Obispo County.

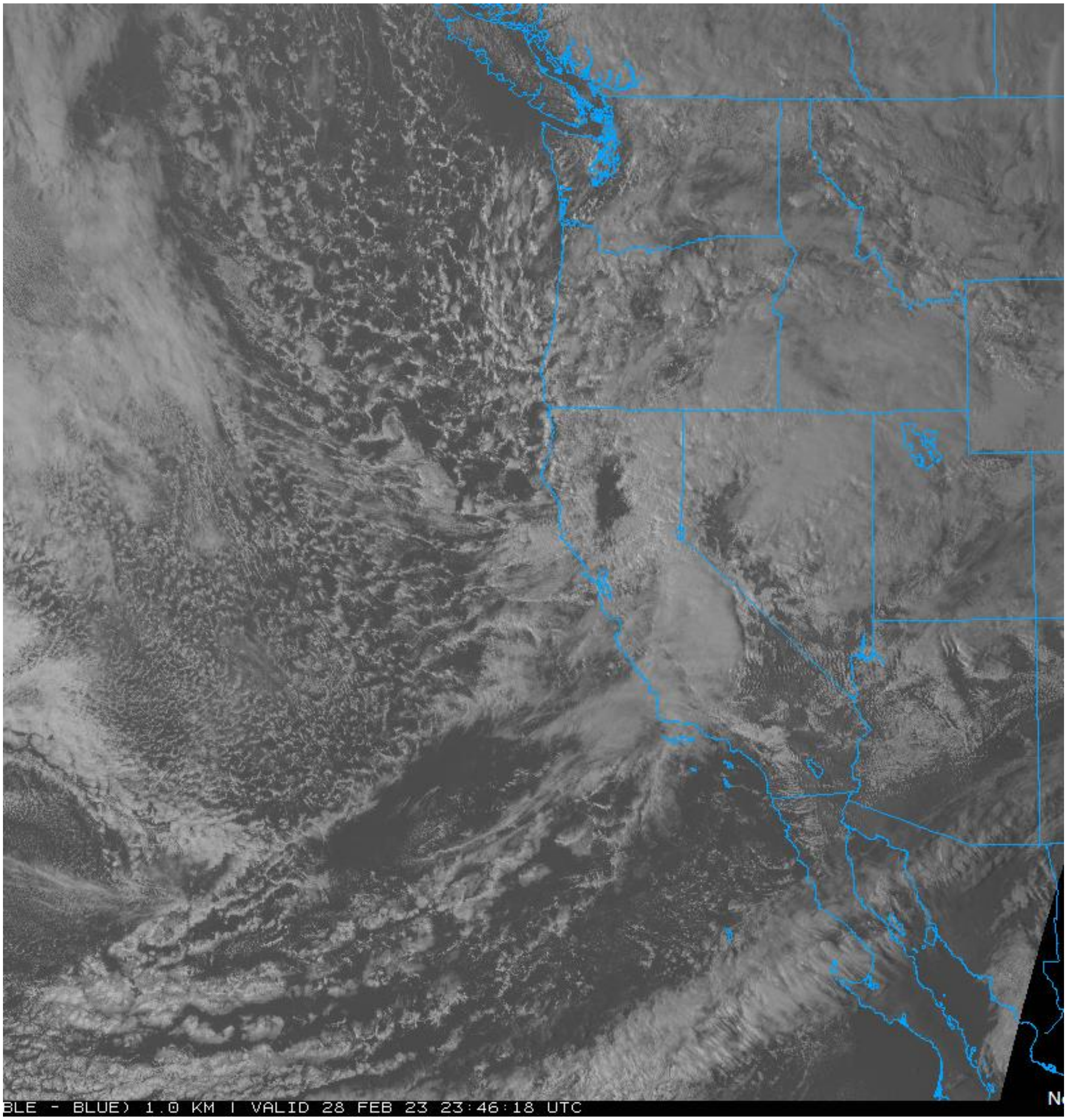

Figure 5.42 Visible spectrum satellite image of western U.S. and eastern Pacific region at 1546 PST February 28

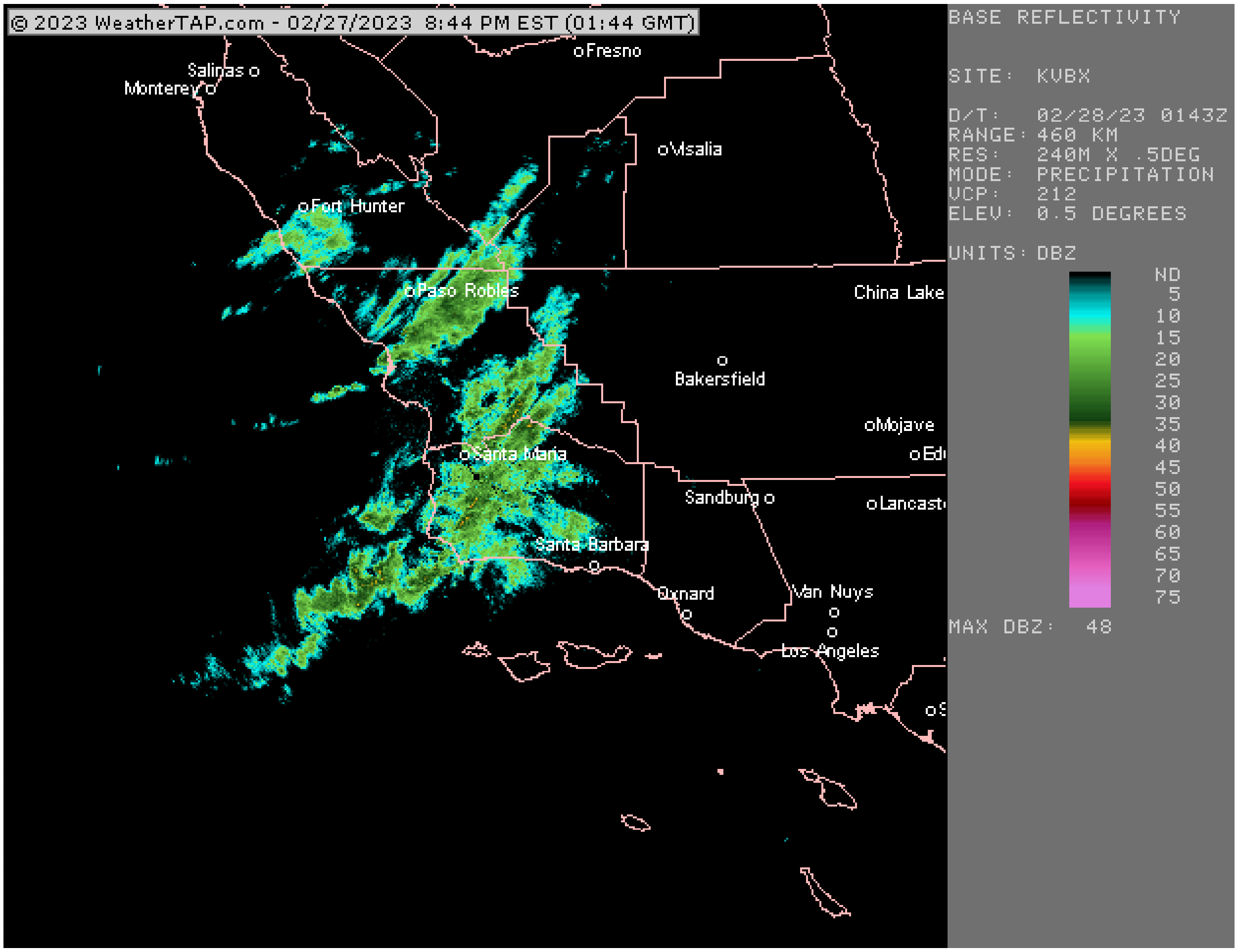

Figure 5.43 Radar image at 1744 PST February 27

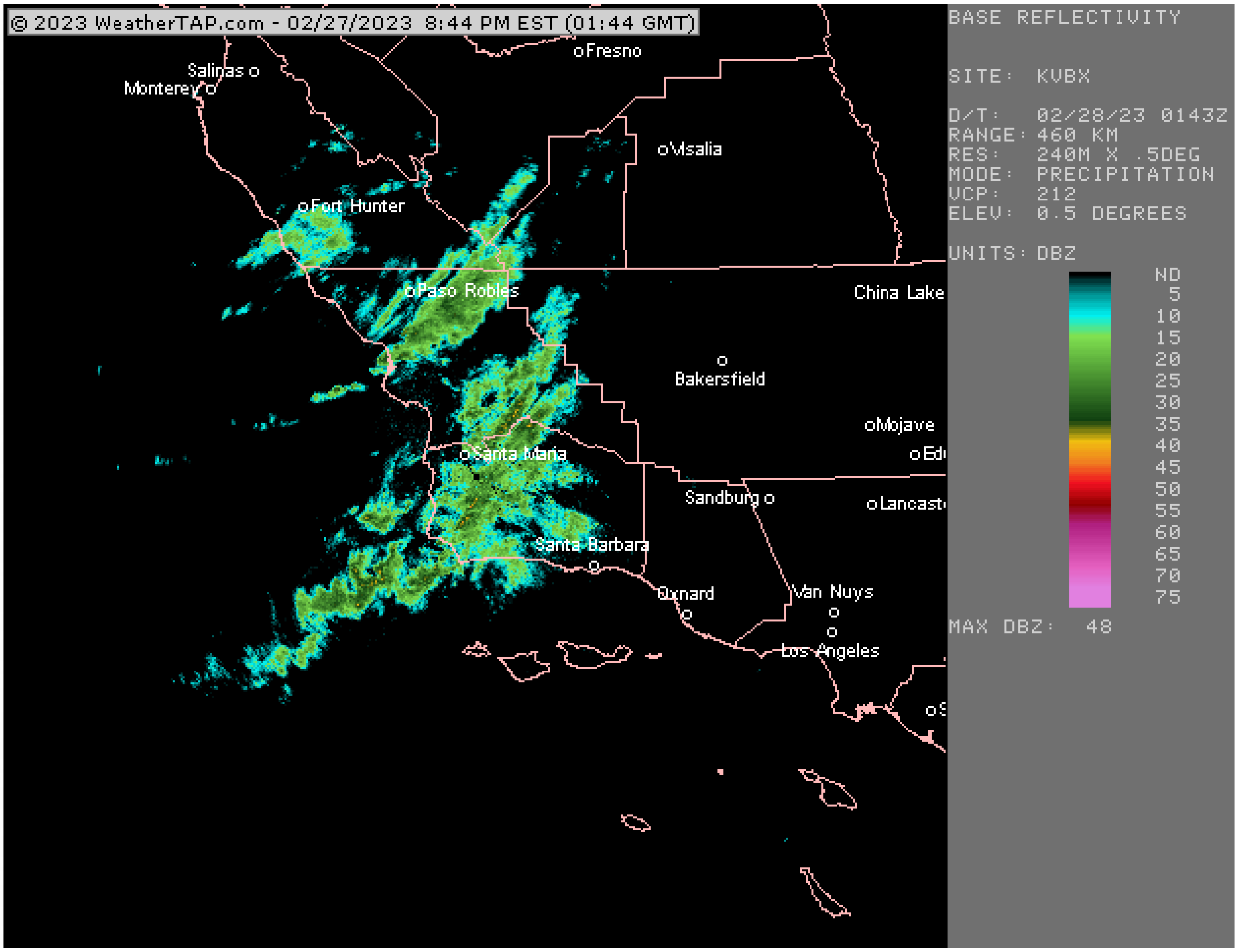

Figure 5.44 Radar image at 1744 PST February 27

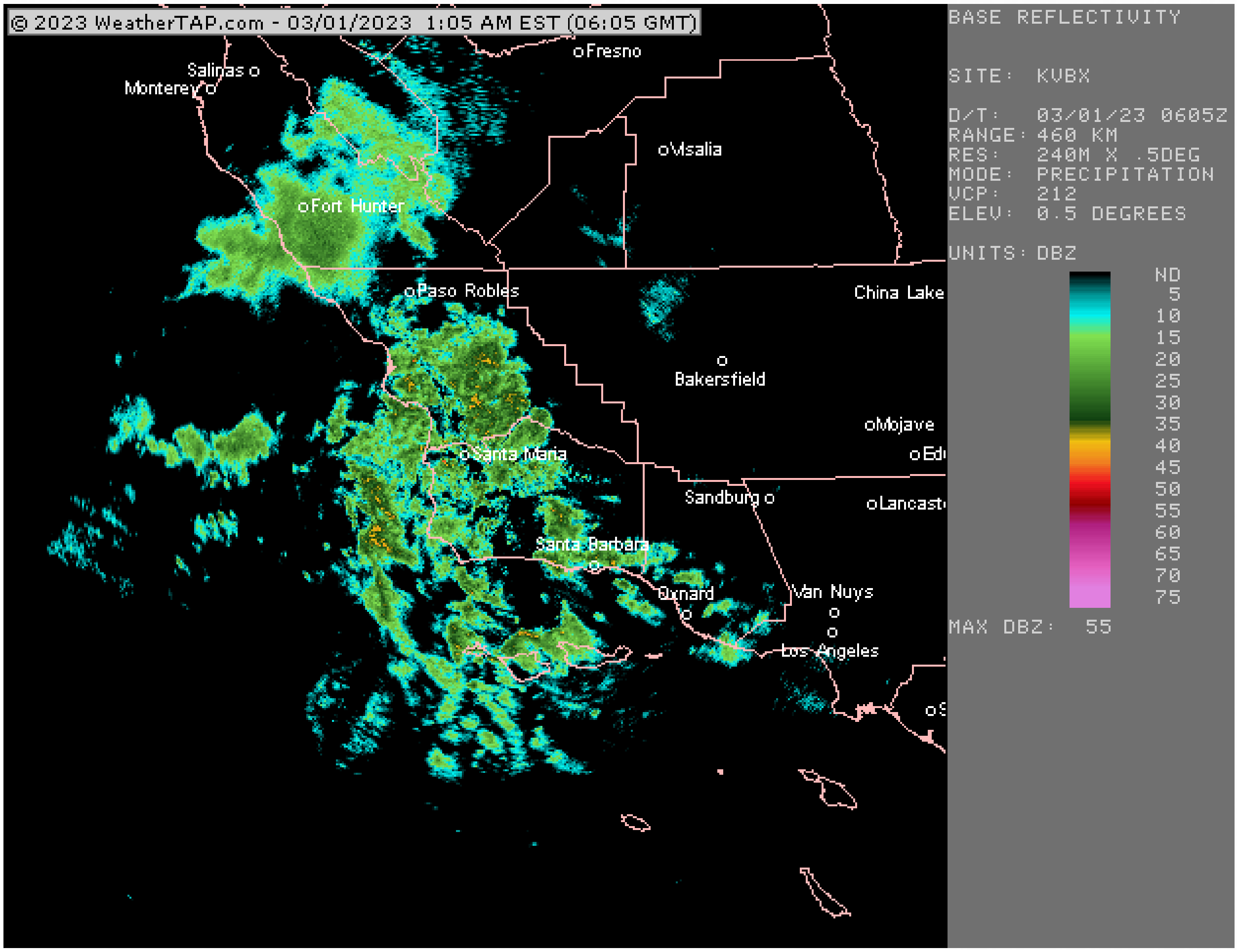

Figure 5.45 Radar image at 2205 PST February 28

March 5

A large and cold trough approached the northern and central California coast on March 4, moving inland on March 5. This system was far enough to the north that San Luis Obispo County had generally light and disorganized rainfall, with totals mostly a quarter to half inch in the central and southern portions of the county during a roughly 24-hour period. Figure 5.46 is a satellite image on the morning of March 5, and Figure 5.47 a corresponding radar image as some weak precipitation bands were moving across the area.

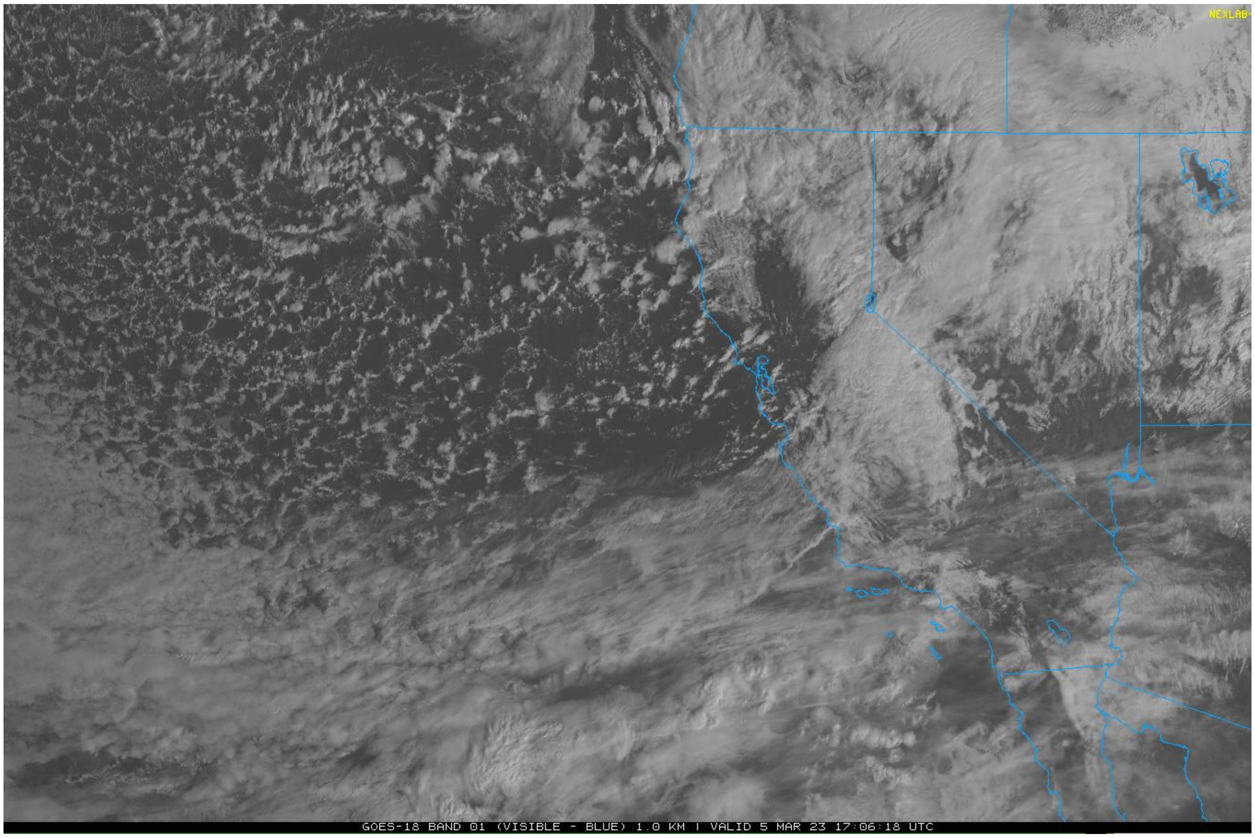

Figure 5.46 Visible spectrum satellite image at 0906 PST March 5

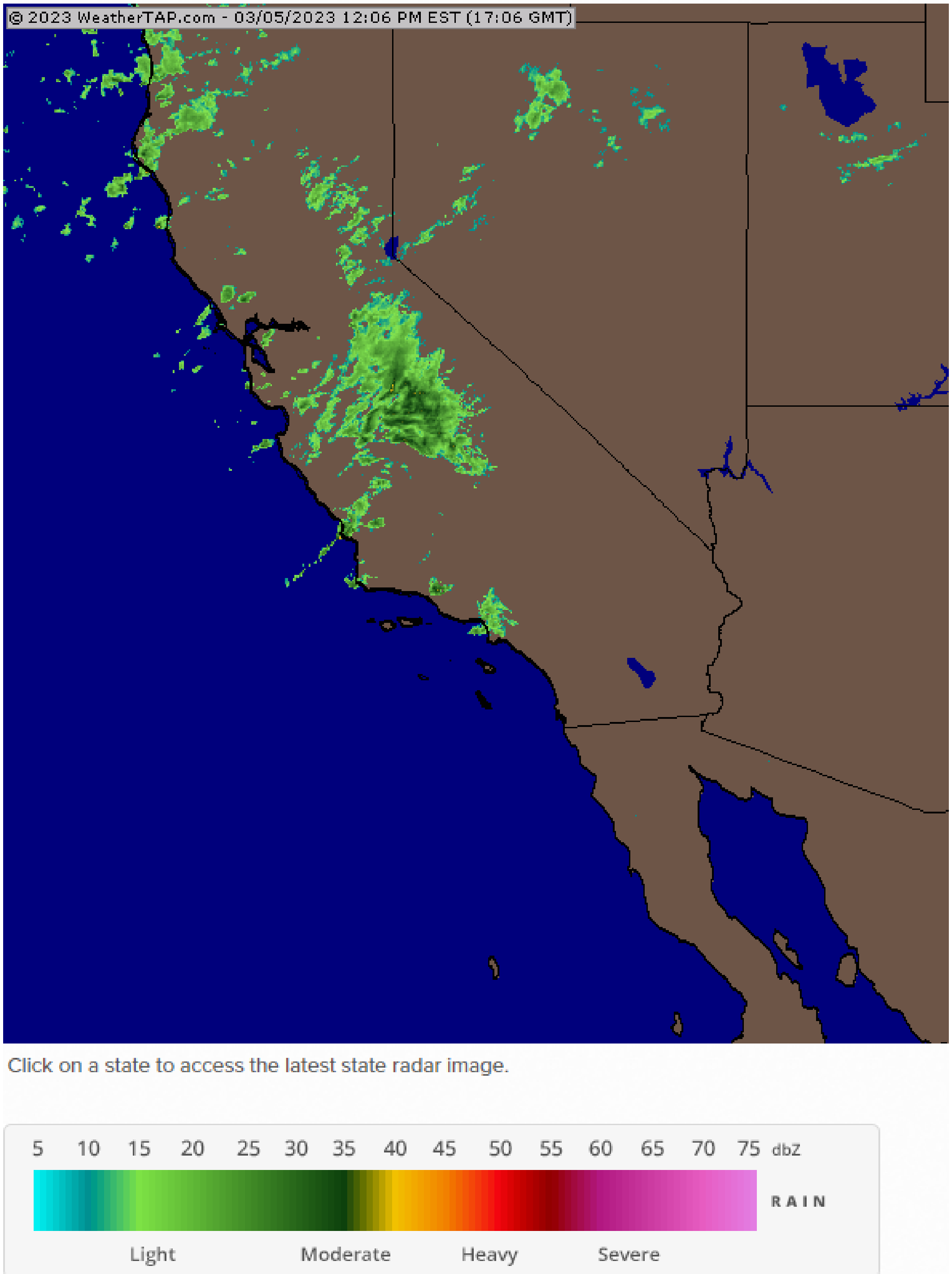

Figure 5.47 Regional weather radar image at 0906 PST March 5

March 10

A long subtropical moisture plume developed and brought significant rainfall to the area on March 10-11, with moderate to heavy rates at times. The freezing level was quite high in this moisture plume, rising to near 10,000 feet elevation. Totals of over 3" of rainfall were common in San Luis Obispo County during this time period. Figure 5.48 is a satellite image of this moisture plume, and Figure 5.49 a Vandenberg radar image during this time period.

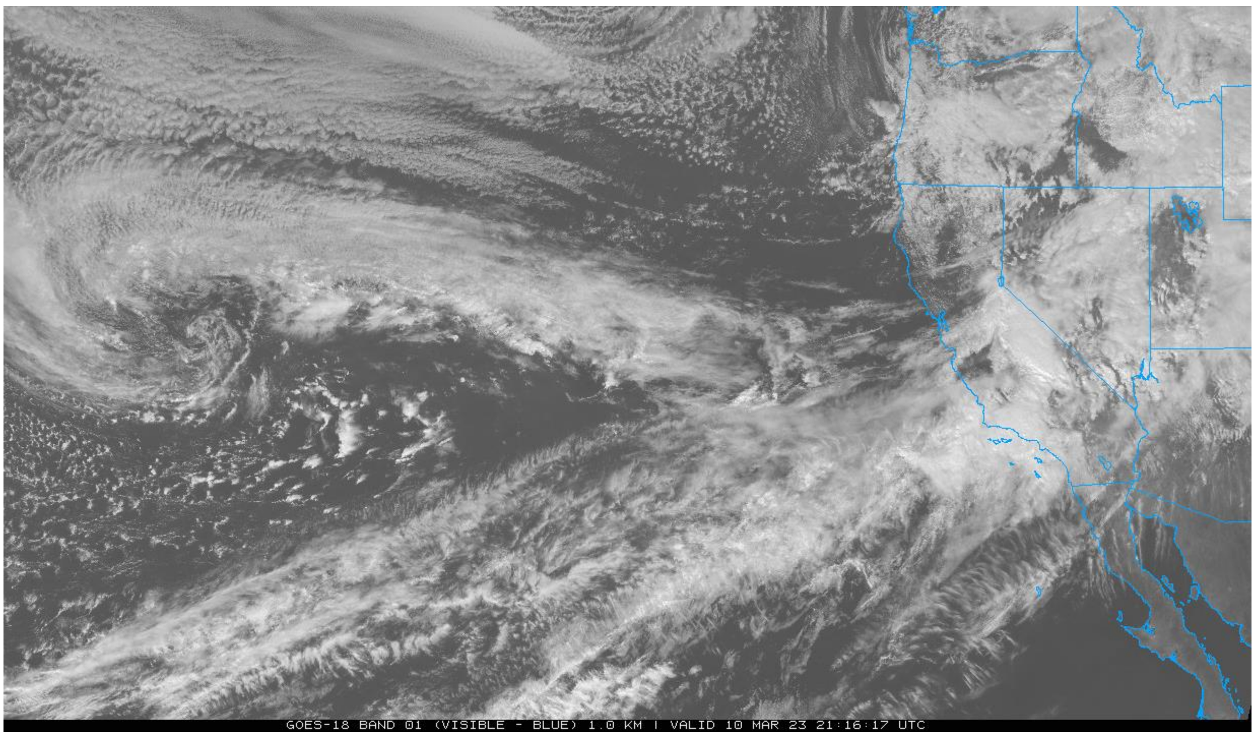

Figure 5.48 Visible spectrum satellite image of at 1316 PDT March 10

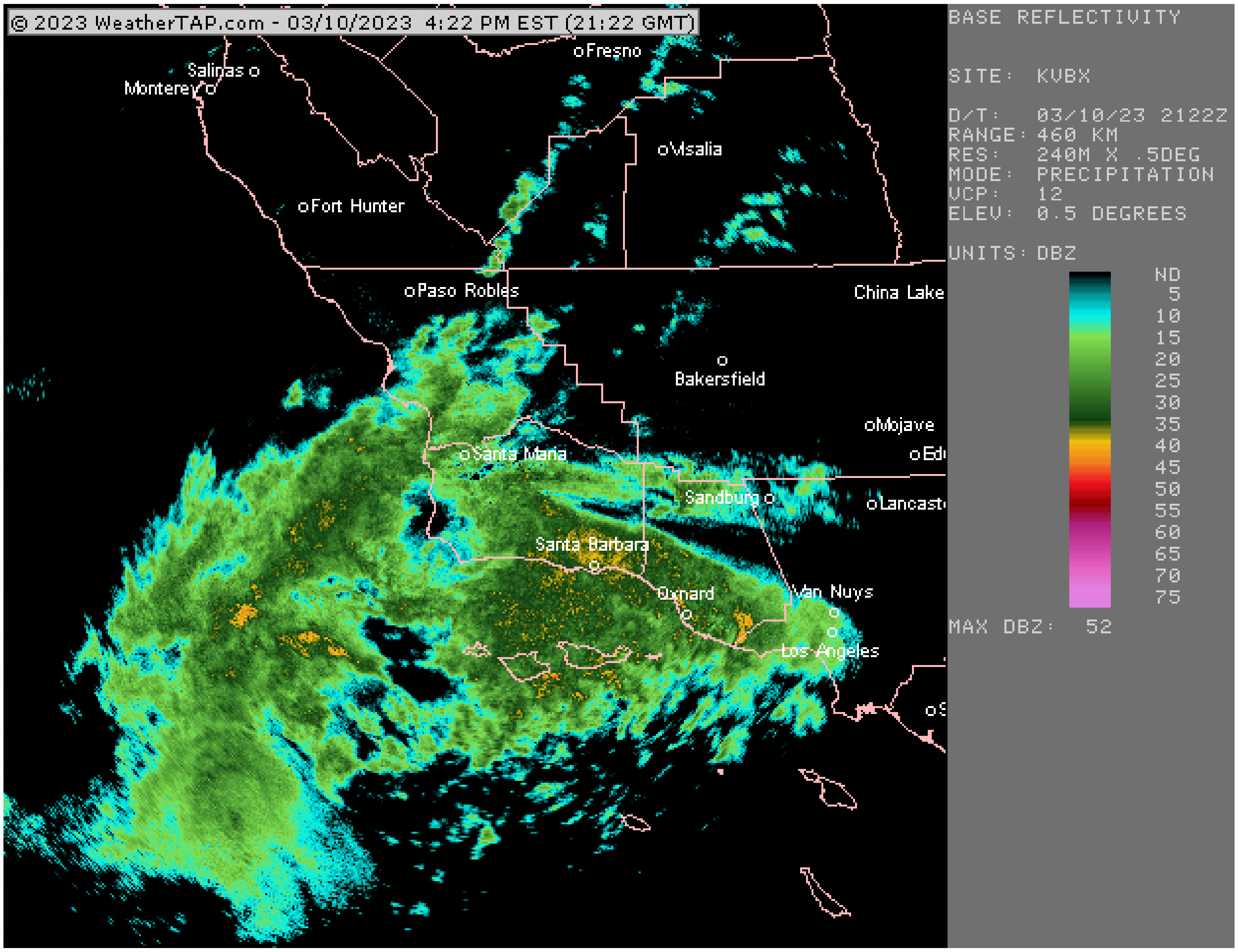

Figure 5.49 Vandenberg radar image at 1322 PDT March 10

March 14

Another major storm system on March 14 brought rainfall totals of 2-4 inches for many mountainous areas, with some locally higher totals. Figure 5.50 is a satellite image on the morning of March 14, and Figure 5.51 a radar image near this time. Figure 5.52 shows forecast rainfall amounts for this event (from the California Nevada Regional Forecast Center) and Figure 5.53 shows observed rainfall totals in the area. The Lopez Lake area generally had rainfall in the 2-3" range with much heavier totals (to locally 5+") in central SLO County.

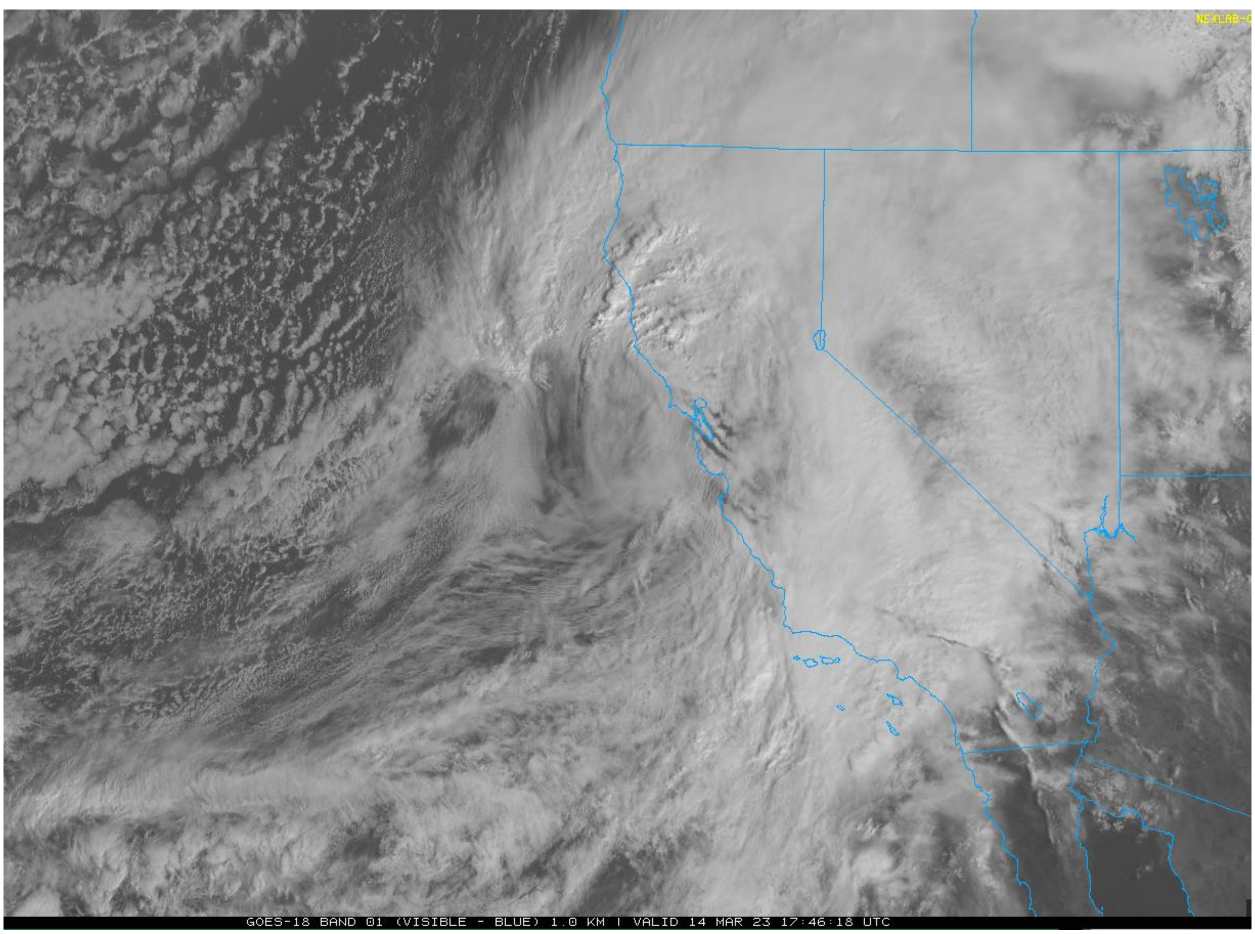

Figure 5.50 Satellite image at 1046 PDT March 14

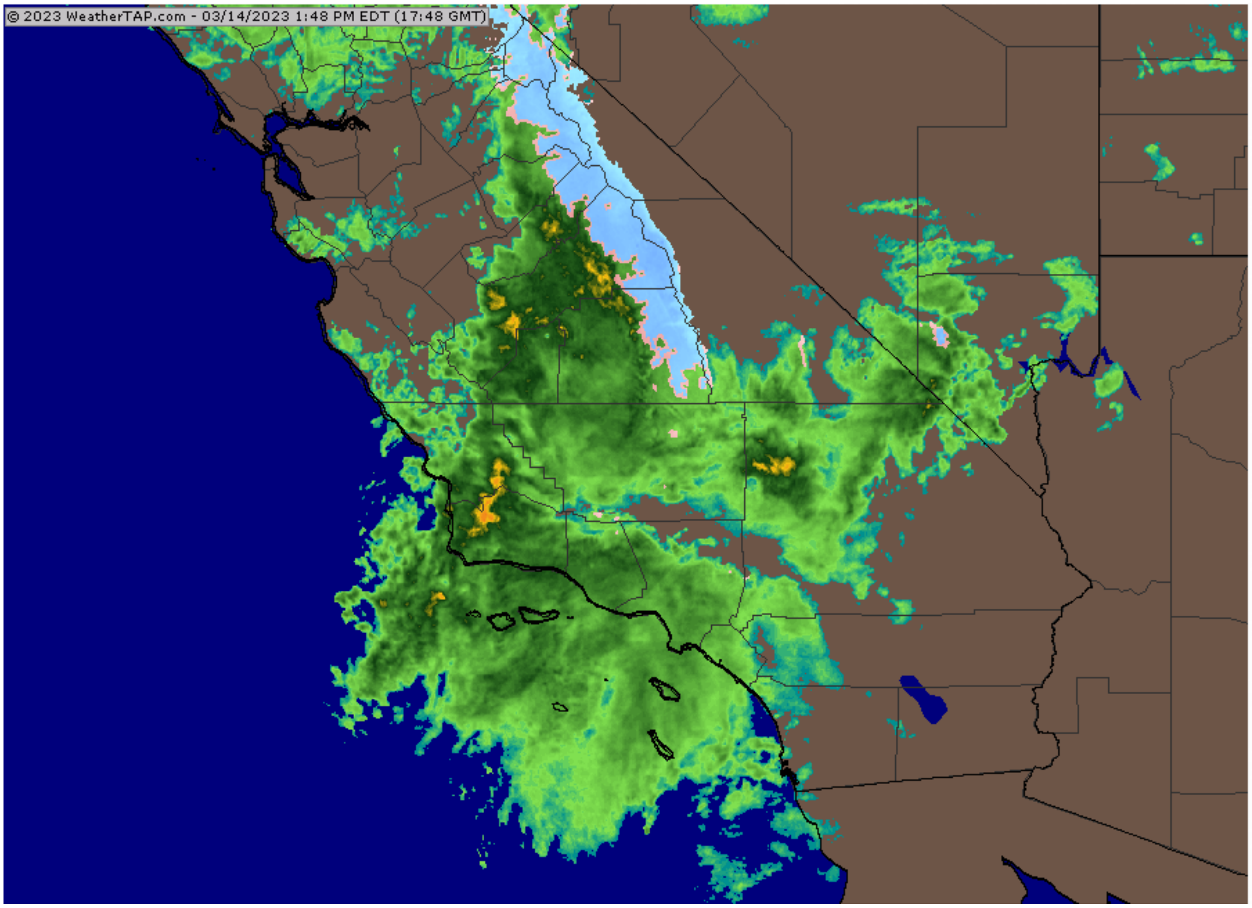

Figure 5.51 Regional radar image at 1048 PDT March 14

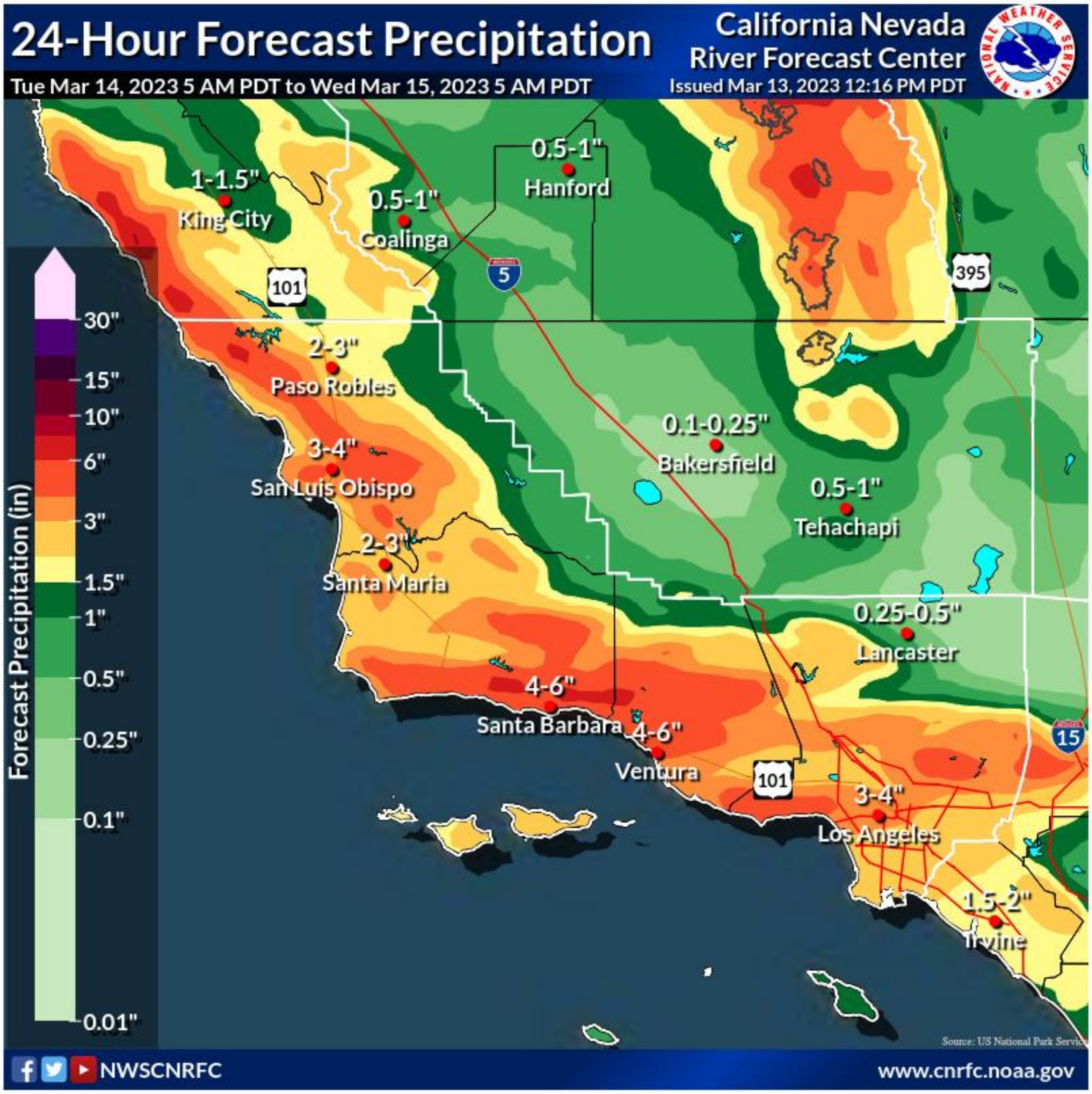

Figure 5.52 Rainfall amounts forecast for the March 14 event

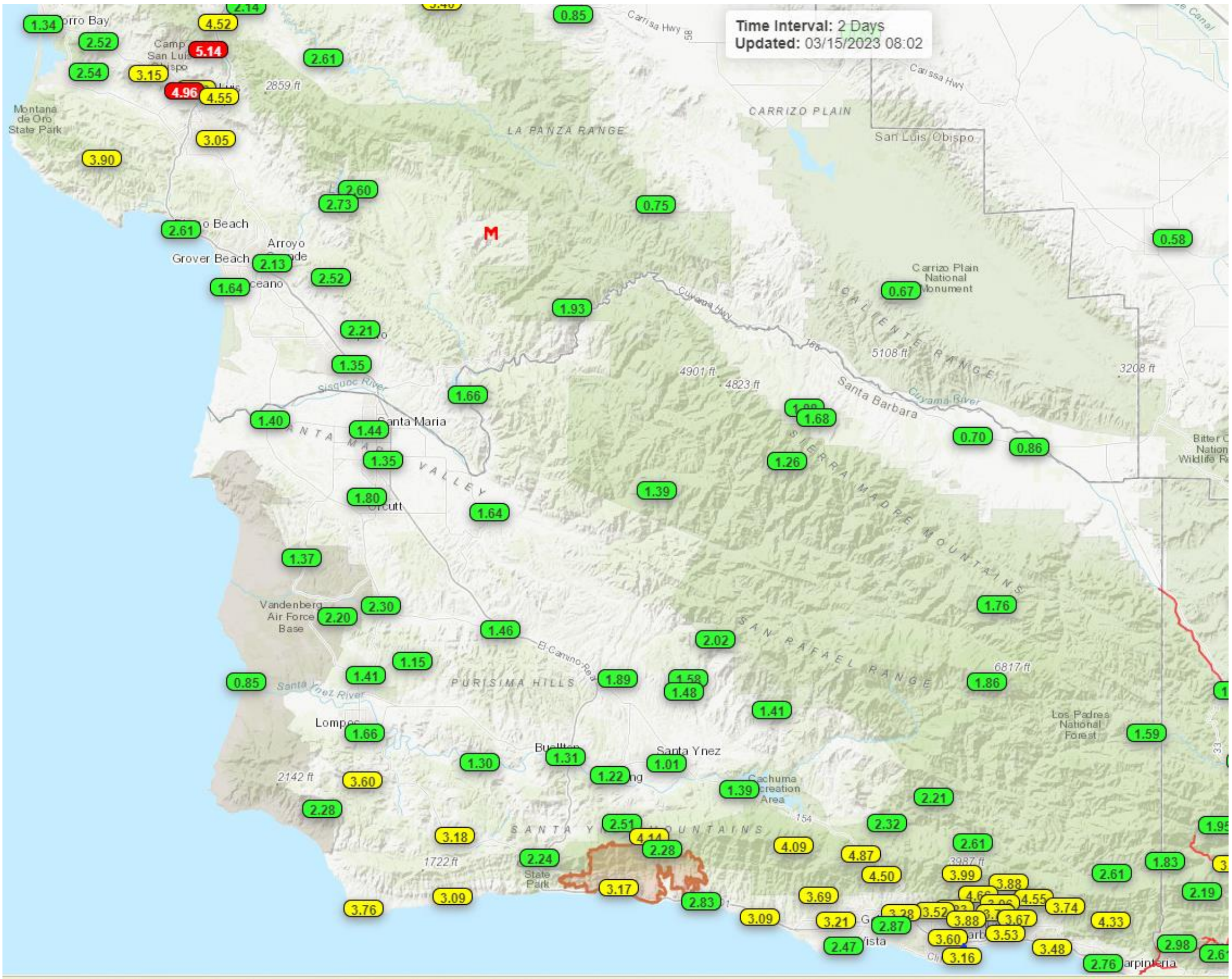

Figure 5.53 Rainfall totals ending on the morning of March 15

March 21-22

Another deep trough brought a major two-day rainfall event on March 21-22. Figure 5.54 is a satellite image on the afternoon of March 21. A regional radar image at this time (Figure 5.55) shows large areas of precipitation and a distinct low center near the Bay Area. Precipitation totals in mountainous southern portions of SLO County were generally in the 2.0 – 3.5" range during this event (Figure 5.56).

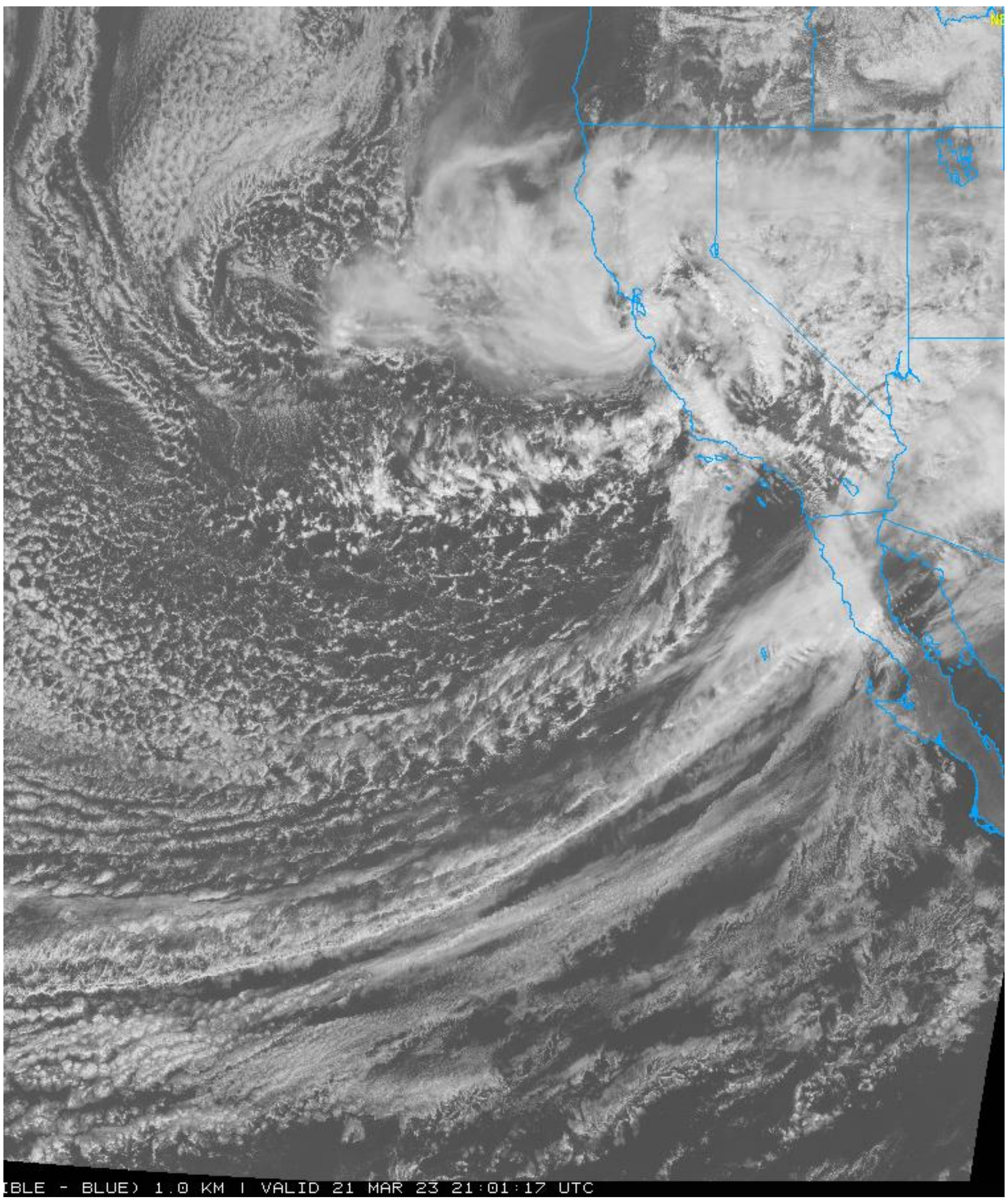

Figure 5.54 Visible spectrum satellite image at 1401 PDT March 21

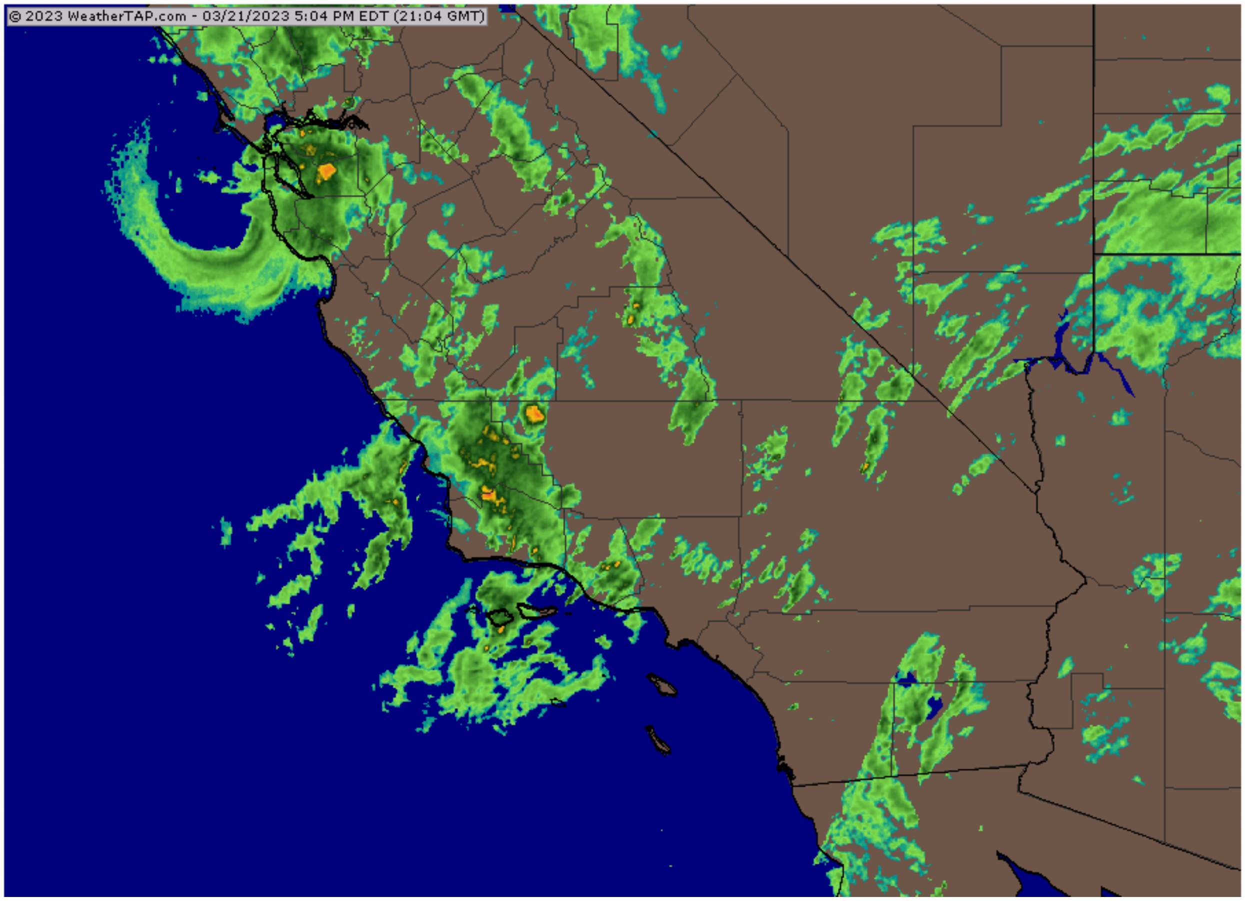

Figure 5.55 Regional radar image at 1404 PDT March 21

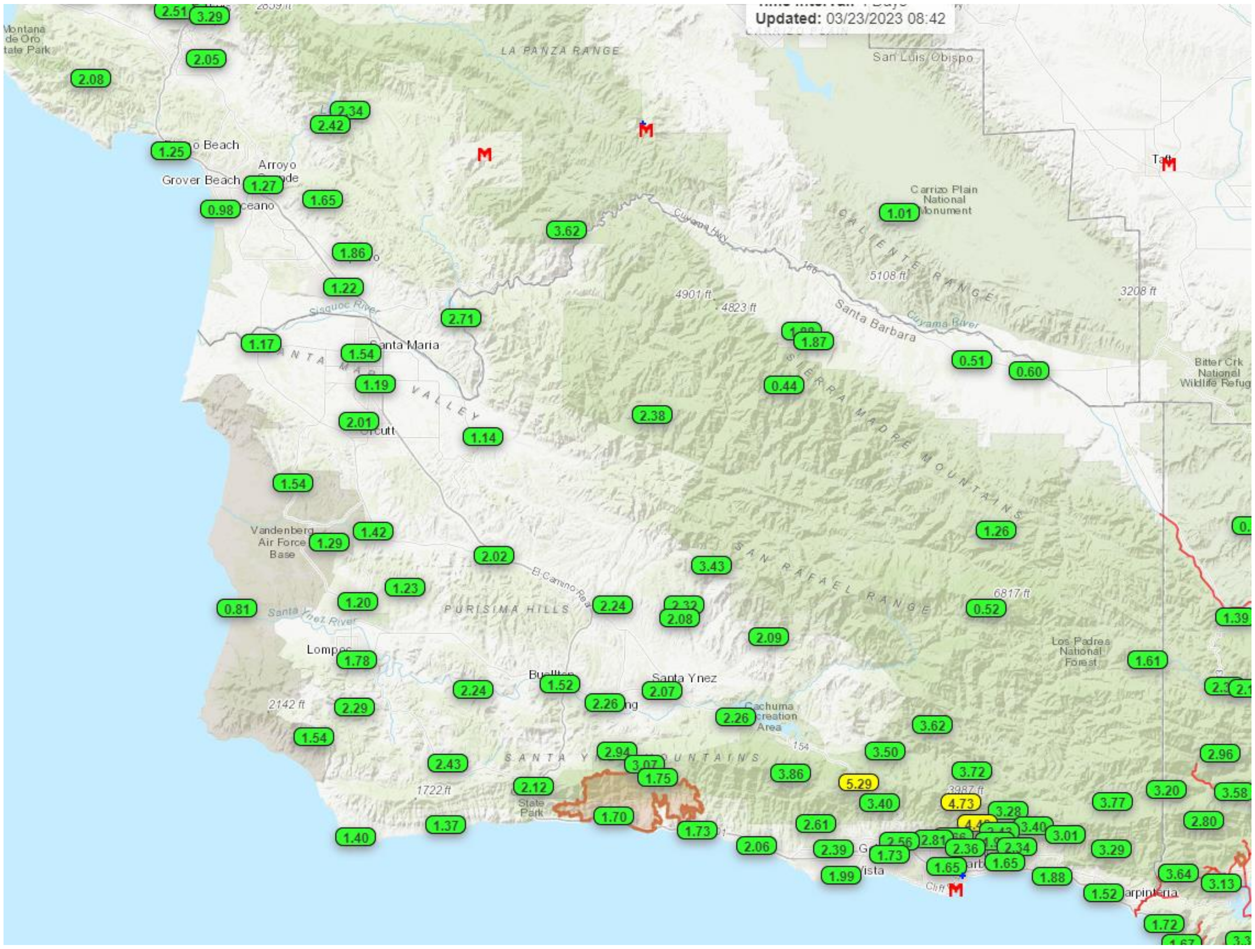

Figure 5.56 Storm rainfall totals for March 21-22

March 28-29

Another significant rainfall event late on March 28 through the 29th rounded out the month. An initial band of precipitation moved into the area on the night of March 28 with additional band and showers through the 29th. Figure 5.57 is a satellite image later in the event, on the evening of March 29, showing a distinct trough center off the coast of central California. Figure 5.58 is a corresponding regional weather radar image. Figure 5.59 shows rainfall totals with this system.

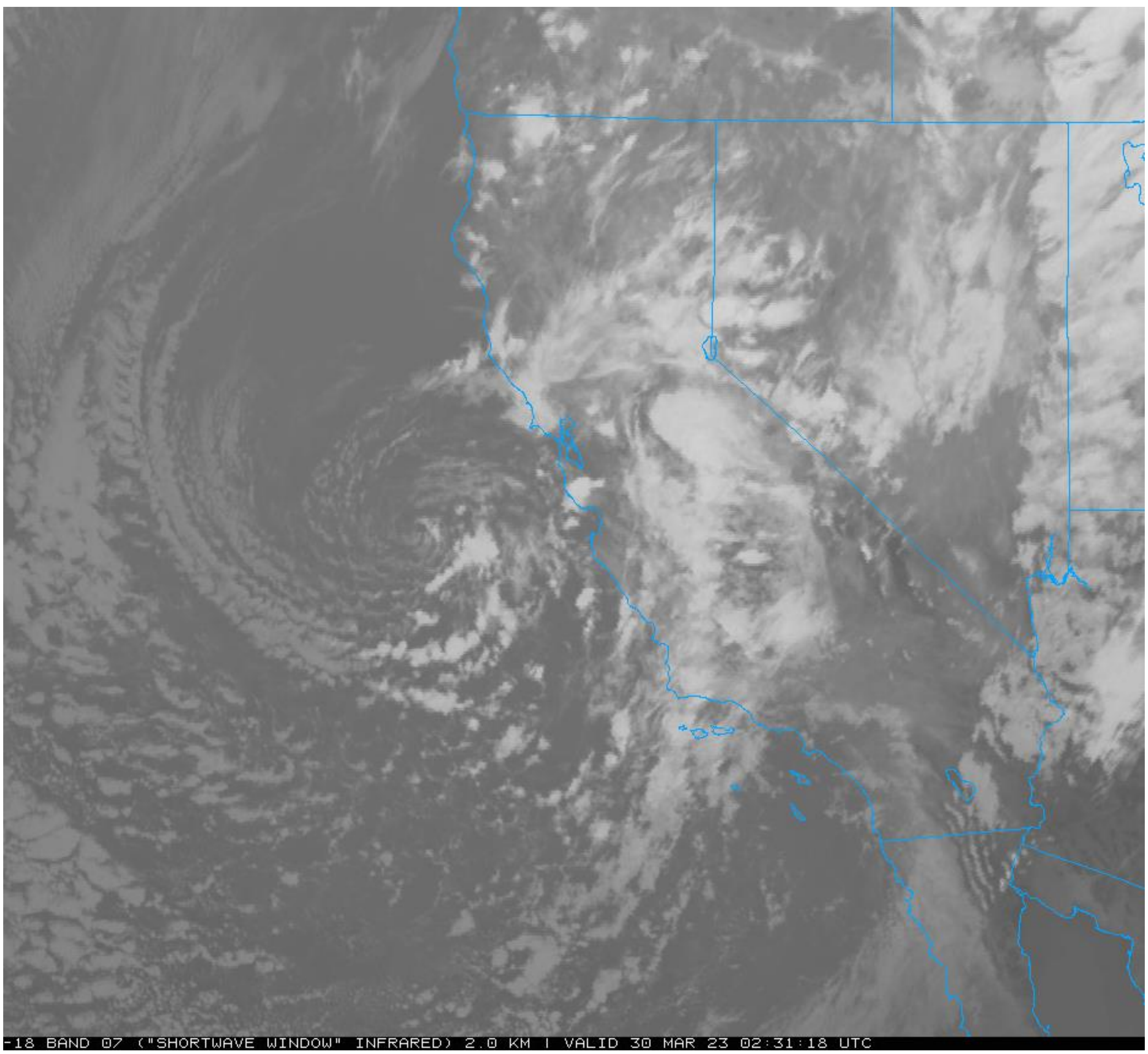

Figure 5.57 Infrared satellite image at 1931 PDT March 29

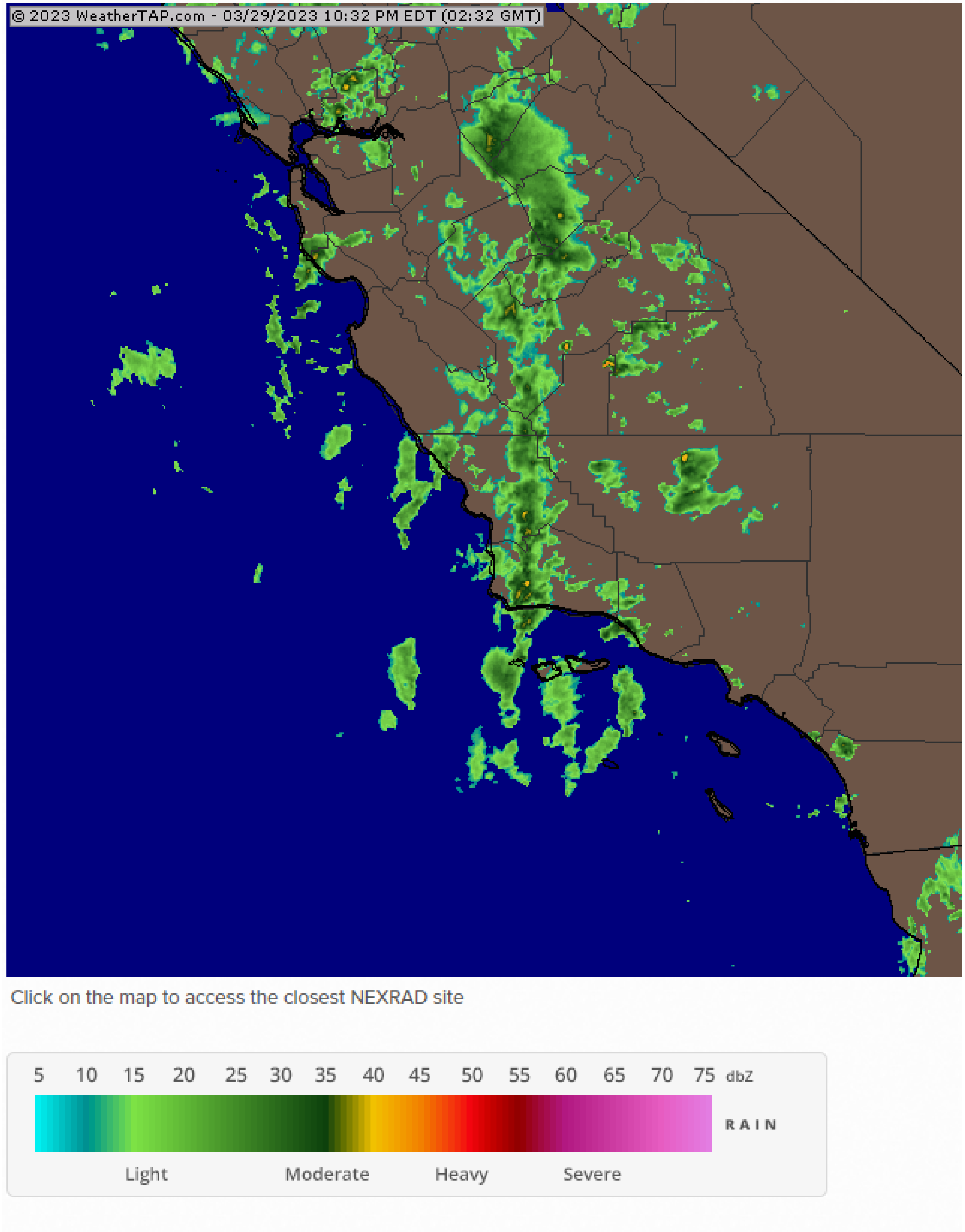

Figure 5.58 Regional radar image at 1932 PDT March 29

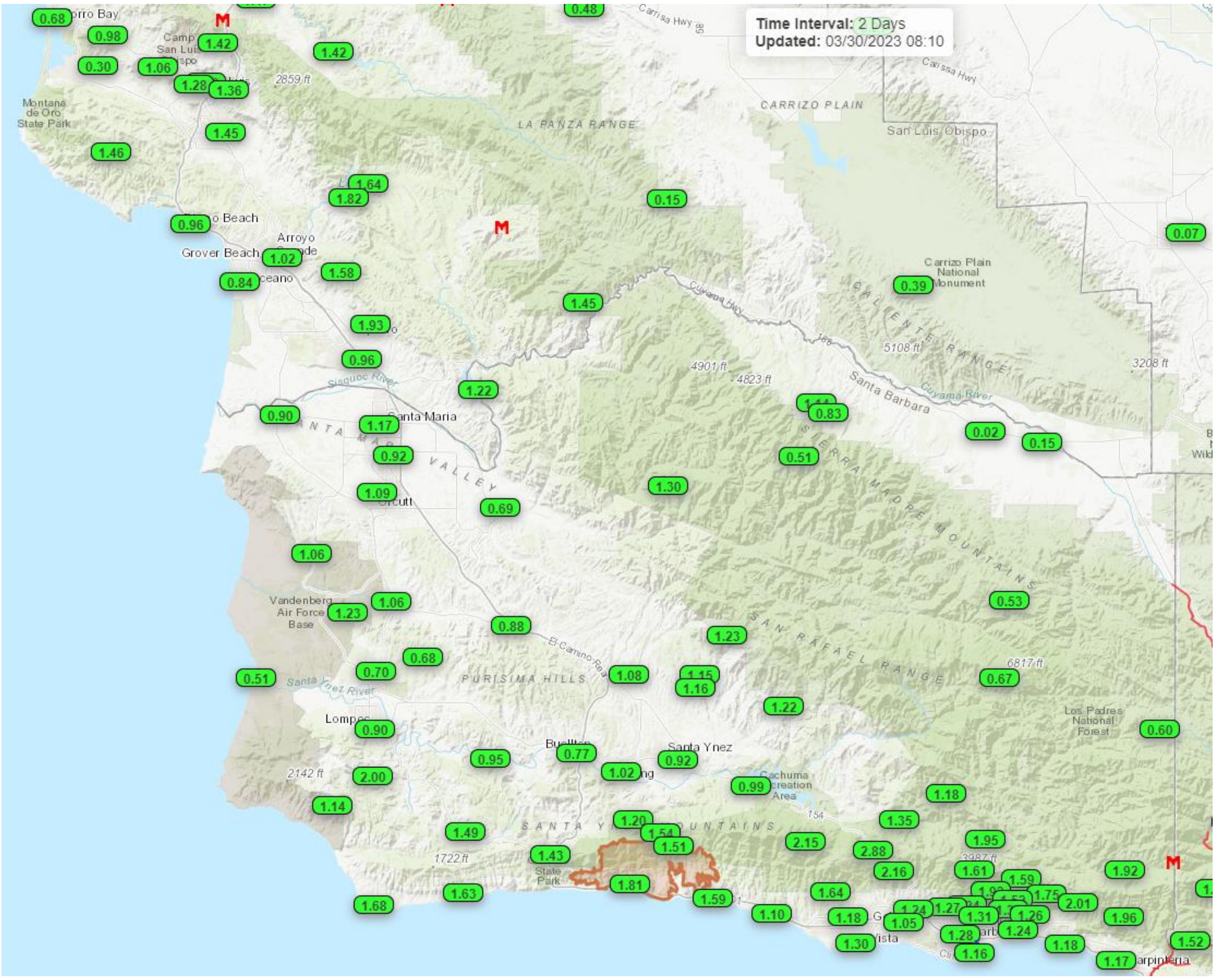

Figure 5.59 Rainfall totals from the March 28-29 event

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7. APPENDIX A

BACKGROUND ON CLOUD SEEDING IN SANTA BARBARA COUNTY

There is a long history of cloud seeding programs being conducted in Santa Barbara County, and more recently in adjacent San Luis Obispo County. Some of these have been research programs, while others have been operational programs. The research programs have been conducted to better understand winter storm systems that impact the Central Coast region and also to attempt to evaluate the potential impacts of cloud seeding, especially in terms of any additional rainfall that can be attributed to the cloud seeding activities. Some of these research programs employed randomization techniques whereby approximately one-half of the seedable events were deliberately left unseeded in order to provide data for comparison with the seeded events. Operational programs have been conducted with the primary objective being to maximize the amount of rainfall produced through the cloud seeding activities. As a consequence, randomization is typically not employed with operational programs since the goal is to produce the maximum impact, not to demonstrate that cloud seeding "works" or to document the amount of the cloud seeding increases. Programs in the County date back to the early 1950s, the result of the pioneering work done in the field of weather modification in the late 1940s by Drs. Vincent Schaefer and Bernard Vonnegut.

Table 1 summarizes research programs conducted in Santa Barbara County. There were also some early operational programs conducted in the 1950s and a later program in 1978. The 1978 program was conducted due to drought conditions. The design of the current program is based upon the results obtained from the Santa Barbara research program Phase I and II. Table 2 provides a summary of some of the earlier operational programs.

Table 1
Summary of Santa Barbara Research Programs

Name	Time Period	Study Area	Sponsor(s)	Design	Results
Santa Barbara I	1957-1960	Higher Elevations of Santa Barbara and Ventura Counties	State of California, University of California, Santa Barbara County, Ventura County, National Science Foundation, U.S. Weather Bureau, U.S. Forest Service	Randomized seeding using ground-based silver iodide generators	Indications of a 45% increase, but results were not statistically significant (Neyman, et al, 1960) (Elliott, et al, 1962)
Water Balance of Orographic Clouds	1960-1963	Santa Ynez and San Gabriel Mountain Ranges	National Science Foundation	Analysis of Precipitation and Rawinsonde data during winter storms	Approximately one quarter of the orographically produced condensate fell as precipitation in the two mountain areas. More precipitation is produced in unstable versus stable air masses
Convection Band Study	1960-1963	Santa Barbara County	National Science Foundation	Analysis of Precipitation and Rawinsonde data during winter storms	The discovery that convection bands are a common feature of winter storms. Bands 20-40 miles wide centered some 30 to 60 miles apart Elliott and Hovind, 1964
Santa Barbara II: Phase I	1967-1971	Santa Barbara County	Naval Weapons Center, China Lake, California	Randomized seeding of winter convection bands from a single ground site using high output silver iodide flares	Increases in convection band precipitation as high as 50%, several sites statistically significant Brown et al, 1974
Santa Barbara II: Phase II	1970-1974	Santa Barbara County	Naval Weapons Center, China Lake, California	Randomized seeding of winter convection bands using aircraft	Increases in convection band precipitation as high as 100%, several sites statistically significant Brown et al, 1974

Table 2 Summary of Earlier Santa Barbara Operational Programs

Time Period	Target Area	Sponsor	Design	Results
1950-1953, 1955	South Coast, Santa Ynez Basin, Cuyama Valley	Santa Barbara County Water Agency	Ground Based Silver Iodide Generators	Estimated 1.35 to 5.09-inch increases for 1955 program
1978	North-east portion of Santa Barbara County	Santa Barbara County	Ground based, high output silver iodide flares	Estimated increases of approximately 40%

The Santa Barbara County Water Agency (Agency) completed a number of tasks during 1981 designed to reactivate cloud seeding activities within the County. These tasks included: 1) preparation of a Negative Declaration Statement (#81-ND-87), 2) conducting a public hearing (December 10, 1981), and 3) obtaining a Weather Resource Management permit from the California Department of Water Resources. North American Weather Consultants (NAWC) was awarded an initial contract from the Agency (dated January 11, 1982) to conduct an operational cloud seeding program during the remainder of the 1982 winter season. Periodic contracts were awarded to NAWC by the Agency to continue these operational programs in a nearly continuous fashion through the 1997 Water Year.

Atmospherics, Inc. of Fresno, California was awarded a contract to conduct an operational program during the 1998 Water Year. Weather Modification, Inc., of Fargo, North Dakota, was awarded a contract by the Agency to conduct operational programs for the 1999 through 2001 Water Years. NAWC, under contract with the Agency, resumed its conduct of operations for the County during the winter of 2001-2002. This program utilized a revised project design based upon the highly successful results of earlier research conducted by NAWC (e.g., Santa Barbara II phase I and phase II experiments). The Agency renewed NAWC's contract to conduct the cloud seeding operations for the 2002-03 winter season. The Agency released an RFP for another three-year program during the early summer of 2003. NAWC was awarded this contract, which resulted in operations being conducted during the 2003-2004, 2004-2005 and 2005-2006 rainy seasons. The revised design, originally implemented during the 2001-2002 rainy season, was utilized in conducting these programs. The Agency released another RFP for a three-winter program during the spring of 2007. NAWC was again selected to perform this work, which would include both ground and airborne seeding. A large fire impacted substantial portions of the upper Santa Ynez watershed during the summer of 2007 (the Zaca fire). As a consequence, the Agency decided that no cloud seeding would be conducted during the 2007-2008 winter season in the Upper Santa

Ynez watershed. The Agency decided to conduct a program designed to only affect the Twitchell watershed. The Agency expanded the program for the 2009-2010 program to include both the Twitchell and Upper Santa Ynez watersheds although restrictions were in place to avoid seeding impacts in some recent burn areas (La Brea, Jesusita, Gap and Tea fires). The Agency released another RFP for a three-winter program during the summer of 2011. NAWC was again selected to perform this work, which would include both ground and airborne seeding. Only ground seeding was conducted during the 2011-2012 and 2012-2013 rainy seasons. The Agency released another RFP for a three-winter program during the summer of 2014. NAWC was again selected to perform this work, which would include both ground and airborne seeding for the 2014-2015 through the 2016-2017 rainy seasons. NAWC has continued to operate this program, utilizing only ground-based sites in many seasons due to budgetary constraints. Table 3 provides a summary of NAWC operations since 1981.

Research has demonstrated that properly conducted cloud seeding programs offer an environmentally safe and cost-effective means of augmenting precipitation from winter storms. NAWC conducted a study for the Santa Barbara County Water Agency (Thompson and Griffith, 1987), which assessed the precipitation augmentation potential from seeding wintertime cloud bands moving over Santa Barbara County. That assessment covered a sixty-one (61) year period (1920-1980). A follow-on study (Solak, et al., 1996) covered the period from 1981 through 1994, applying the same analysis methods. A key conclusion of these studies was that, under average conditions, seasonal precipitation could be optimally enhanced by 18 to 22 percent at Juncal and Gibraltar Dams through seeding of all appropriate precipitation bands from October through April. Seasonal increases of that magnitude could add as much as 4.5 to 5.0 inches of precipitation to the average seasonal total. Realizing the importance and benefit of this additional rainfall, the water purveyors of Santa Barbara County, under the administrative leadership of the County's Water Agency and/or the Flood Control District have sponsored a cloud seeding program in all water years since 1982, with the exception of 1985-1986 and 2007-2008. The 1985-1986 and 2007-2008 programs were canceled due to fires which produced large burn scars in the project areas, which, in turn, created concerns about the potential for excessive erosion and mudslides.

Availability of fresh water in adequate supplies is obviously of paramount importance. Local precipitation has been the major source of water for most areas of California. As part of Santa Barbara County's water resource development and management strategies, cloud seeding operations have been routinely utilized to augment natural precipitation, helping to stabilize annual fresh water supplies. Cloud seeding for precipitation enhancement has been shown to be an effective tool, which carries a very attractive long-term benefit/cost ratio.

Table 3
Historical Operational Cloud Seeding Periods in Santa Barbara County, Water Year 1982 to Present

OPERATIONAL PERIOD	TARGET AREA	REMARKS
Jan 15-Apr 15, 1982	Santa Barbara County except South Coast	Airborne seeding, weather radar support provided by Vandenberg Air Force Base. Ground based pyrotechnic flare firing at Tranquillion Park.
Dec 1, 1982-Jan 26, 1983	Santa Barbara County except South Coast	Airborne and ground based pyrotechnic seeding suspended in late January due to heavy rainfall and Lake Cachuma approaching capacity.
Mar 1, 1984-Apr 30, 1984	North County	Airborne seeding and ground based pyrotechnic seeding.
Nov 1, 1984-Apr 30, 1985	Santa Barbara County except South Coast	Airborne seeding and ground based pyrotechnic seeding.
1985-1986		No program due to burn areas in San Luis Obispo and Ventura Counties
Nov 1, 1986-Mar 31, 1987	Santa Barbara County except South Coast	Airborne seeding. Ground based pyrotechnic seeding replaced with two ground-based silver iodide generators (Mt. Lospe and Sudden).
Nov 1, 1987-Mar 31, 1988	Santa Barbara County except South Coast	Airborne seeding. Implementation of remotely controlled ground-based silver iodide generators began (Mt. Lospe). The use of a computerized targeting model (GUIDE) began.
Nov 1, 1988-Apr 30, 1989	Santa Barbara County except South Coast	Provision of a project specific weather radar was initiated. Airborne seeding. Four manual generator sites (Gaviota, La Cumbre, Sudden, Graham Ranch) and one remote site (Mt. Lospe). Dedicated weather radar.
Nov 1, 1989-Apr 30, 1990	Santa Barbara County except South Coast	Airborne seeding. Four manual generator sites and one remote site. Special project suspension criteria developed for lower Santa Ynez River flow below Bradbury Dam. Dedicated weather radar.

OPERATIONAL PERIOD	TARGET AREA	REMARKS
Nov 1, 1990-Apr 30, 1991	Santa Barbara County except South Coast	Special targeting criteria adopted for Painted Cave burn area. Lower Santa Ynez flow suspension criteria continued. Airborne seeding. Three remotely controlled ground generators (Sudden, La Cumbre and Graham Ranch). One ground based manual site (Gaviota). Dedicated weather radar.
Nov. 1, 1991-Apr 21, 1992	Santa Barbara County except South Coast	Targeting restrictions continued for Painted Cave burn area plus Santa Ynez River flow. Airborne seeding. Four remotely controlled and one manually operated ground-based silver iodide generators. Dedicated weather radar.
Dec. 1, 1992-Mar 31, 1993	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Cachuma Reservoir spilled for the first time since the 1982-83 winter season. Santa Ynez River flow restrictions continued. New suspension criteria for Twitchell Reservoir inflow adopted. Provision made for acquisition of weather satellite information. Dedicated weather radar.
Dec. 17, 1993-Apr 18, 1994	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Targeting restrictions imposed for the Marre burn area. Santa Ynez River flow and Twitchell Reservoir inflow restrictions continued. Airborne seeding. Six remote generators. Dedicated weather radar.
Nov. 15, 1994-Mar 24, 1995	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Targeting restrictions continued for the Marre burn area. Santa Ynez River flow and Twitchell Reservoir inflow restrictions continued. Airborne seeding. Six remote generators. Cachuma spilled. Dedicated weather radar.
Dec. 14, 1995 - Mar. 13, 1996	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Targeting restrictions for Marre burn area removed. Santa Ynez River flow and Twitchell Reservoir inflow restrictions continued. Continued airborne seeding. 6 remote and 2 manual generators. Dedicated weather radar.
Dec. 9, 1996 - Mar. 22, 1997	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Santa Ynez River flow and Twitchell Reservoir inflow restrictions continued. Airborne seeding. Six remote generators. Two manual generators. Dedicated weather radar.
Nov. 15, 1997-Apr. 30, 1998	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Work performed by Atmospheric, Inc. of Fresno, California. Program onset delayed, operated Jan. 1-Feb. 1, 1998. Program suspended on Feb. 2, 1998 and terminated Mar. 15, 1998 (extremely wet watersheds)

OPERATIONAL PERIOD	TARGET AREA	REMARKS
Dec. 15, 1998-Mar. 31, 1999	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Work performed by Weather Modification, Inc. of Fargo, North Dakota.
Dec. 15, 1999-Apr. 5, 2000	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Work performed by Weather Modification, Inc. of Fargo, North Dakota.
Dec. 8, 2000-Mar. 31, 2001	Santa Barbara County except South Coast plus a portion of the Twitchell Drainage in southern San Luis Obispo County.	Work performed by Weather Modification, Inc. of Fargo, North Dakota.
Dec. 20, 2001 - Mar. 22, 2002	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Revised project design implemented, including airborne seeding and three automated high-output ground-based flare seeding (AHOGS) sites. Custom software utilized to combine NEXRAD and aircraft track data for use in operations.
Nov. 7, 2002 - May 2, 2003	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Airborne seeding and three automated high-output ground-based flare seeding (AHOGS) sites. Custom software utilized to combine NEXRAD and aircraft track data for use in operations.
Nov. 15, 2003 - Apr. 15, 2004	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Airborne seeding and three automated high-output ground-based flare seeding (AHOGS) sites. Custom software utilized to combine NEXRAD and aircraft track data for use in operations.
Nov. 15, 2004 - Apr. 15, 2005	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Airborne seeding and four automated high-output ground-based flare seeding (AHOGS) sites. Custom software utilized to combine NEXRAD and aircraft track data for use in operations. WxWorx display in aircraft cockpit of aircraft location, underlying terrain and current NEXRAD radar data.

OPERATIONAL PERIOD	TARGET AREA	REMARKS
Nov. 15, 2005 - Apr. 5, 2006	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Airborne seeding and five automated high-output ground-based flare seeding (AHOGS) sites. Custom software utilized to combine NEXRAD and aircraft track data for use in operations. WxWorx display in aircraft cockpit of aircraft location, underlying terrain and current NEXRAD radar data.
Nov. 15, 2006 - Mar. 31, 2007	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Airborne seeding and five automated high-output ground-based flare seeding (AHOGS) sites. WxWorx display in aircraft cockpit of aircraft location, underlying terrain and current NEXRAD radar data.
2007-2008 Winter Season	No Operations	Zaca Fire
Nov. 15, 2008 – Apr. 15, 2009	Twitchell watershed located in portions of northern Santa Barbara and southern San Luis Obispo Counties.	Revised project design partially implemented consisting of three high-output ground-based flare-seeding (AHOGS) sites. No aircraft seeding.
Nov. 15, 2009 – Apr. 15, 2010	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Revised project design partially implemented consisting of five high-output ground-based flare-seeding (AHOGS) sites. No aircraft seeding.
Nov. 15, 2010 – Mar. 31, 2011	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Revised project design implemented consisting of airborne seeding and six high-output ground-based flare-seeding (AHOGS) sites.
Dec. 1, 2011 – Apr. 22, 2012	Portions of northern Santa Barbara and southern San Luis Obispo Counties	Revised project design targeting only the northern (Huasna – Alamo) area, using three high-output ground-based flare seeding (AHOGS) sites.

OPERATIONAL PERIOD	TARGET AREA	REMARKS
Dec. 1, 2012 – Mar. 15, 2013	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Revised project design implemented consisting of six high-output ground-based flare-seeding (AHOGS) sites.
Nov. 15, 2013 – Apr. 15, 2014	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Revised project design implemented consisting of airborne seeding and six high-output ground-based flare-seeding (AHOGS) sites.
Nov. 15, 2014 – Apr. 15, 2015	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Revised project design implemented consisting of airborne seeding and six high-output ground-based flare-seeding (AHOGS) sites.
Nov. 1, 2015 – Apr. 30, 2016	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	For the first time in the history of the program, a six month long operational period occurred. This included six months of ground seeding and four months of aerial seeding.
Nov. 1, 2016 – Apr. 30, 2017	Portions of Santa Barbara and southern San Luis Obispo Counties, emphasizing upper and middle Santa Ynez watershed and lower Twitchell watershed	Airborne seeding and six high-output ground-based flare-seeding (AHOGS) sites. Four of the Six AHOGS units were replaced with newly manufactured units that contained updated electronics and video cameras. Meteorological guidance for aircraft seeding operations conducted from Sandy, Utah. In all previous seasons the meteorologist was stationed in Santa Barbara or Santa Maria for the duration of the seeding programs. A new aircraft tracking system known as Spider Tracks was employed.
Nov. 15, 2017- Apr. 15, 2018	Portions of northern Santa Barbara and southern San Luis Obispo Counties	Revised project design targeting only the northern (Huasna – Alamo) area, using three high-output ground-based flare seeding (AHOGS) sites. No seeding in the Upper Santa Ynez Watershed due to Whitter Burn area. Introduction of the in-house HRRR model for cloud seeding guidance.

OPERATIONAL PERIOD	TARGET AREA	REMARKS
Nov. 15, 2018 – Apr. 15, 2019	Portions of northern Santa Barbara and southern San Luis Obispo Counties	Revised project design targeting only the northern (Huasna – Alamo) area, using two high-output ground-based flare seeding (AHOGS) sites. No seeding in the Upper Santa Ynez Watershed due to Whitter and Thomas Burn areas. Continued use of the in-house HRRR script model for cloud seeding guidance.
Dec. 1, 2019 – Apr. 15, 2020	Portions of northern Santa Barbara and southern San Luis Obispo Counties	Operational cloud seeding for only the northern (Huasna – Alamo) area using AHOGS sites. No seeding in the Upper Santa Ynez Watershed. Installation of a new site in southern San Luis Obispo County named Berros Peak.
Dec. 1, 2020 – Apr. 15, 2021	Portions of northern Santa Barbara and southern San Luis Obispo Counties	Operational cloud seeding for only the northern (Huasna – Alamo) area using AHOGS sites. No seeding in the Upper Santa Ynez Watershed.
Dec. 1, 2021 – Mar. 31, 2022	Portions of northern Santa Barbara and southern San Luis Obispo Counties	Operational cloud seeding using AHOGS sites for both the northern (Twitchell, or Twitchell) and the Upper Santa Ynez Watershed.

8. APPENDIX B

2022-2023 CLOUD SEEDING PROGRAM SUSPENSION CRITERIA

A. General Criteria for the Entire Project Area in San Luis Obispo Counties

Whenever the National Weather Service (NWS) issues a severe thunderstorm, flood warning or flash flood warning that affects any part of the project area, the project meteorologist shall suspend operations which may affect that part. Operations will be suspended at least for the period that the warning is in effect.

The Project Meteorologist or District/Agency personnel shall retain independent authority to suspend cloud seeding operations for any part, or all of the project area in the event that unforeseen conditions develop during storm events which in their best judgment have the potential to cause flooding or other adverse conditions anywhere within the project area.

ZONE 3 Lopez Project

San Luis Obispo County Flood Control and Water Conservation District

TO: Zone 3 Advisory Committee

FROM: David Spiegel, PE

DATE: July 20, 2023

SUBJECT: Zone 3 Projects Update

Project Updates:

- Spillway Assessment and Investigation
    - Developing Scope and schedule for Non-destructive testing
    - Remainder of project ~ minimum of $300,000

- Geotechnical Testing & Seismic Alternatives Study of Terminal Reservoir Dam (No Change)
    - GEI is working on Geotechnical Engineering Report
    - Budget ~$500,000

- Cathodic Protection Repair Project
    - Farwest is preparing traffic control plans for encroachment permits
    - Project Kick off TBD
    - Budget ~$449,933

- CO2 Injection System (No Change)
    - CO2 Tank and Carbonic Acid Skid has been delivered
    - Budget ~$256,000

- Chemical Tank Replacement
    - Re-bidding tanks
    - Budget ~$350,000

- Sludge Bed Curtain Wall Rehabilitation
    - Developed new scope
    - Getting new bids
    - ~$50,000 per initial quote

- Membrane Rack Module Replacement
    - Replace second rack membrane modules
    - ~$300,000

- Perimeter Channel Repair
    - Repair storm damaged Terminal Reservoir Perimeter Channel
    - FEMA Claim

Completed Projects

- Tesla Battery Storage
- Lopez WTP Safety Upgrades (Cancelling)
- Equipment Storage Building (Cancelling)
- Chlorine Dioxide Bulk Storage Tank